ALLEN M. PERRY
Managing Editor
EARL WHITEHORNE
Contributing Editor
G. F. WITTIG
Statistical Editor
H. M. CAMERON
Associate Editor
A. E. KNOWLTON
Associate Editor
F. C. WELLS
News Editor
E. R. SEARLES
Assistant Editor

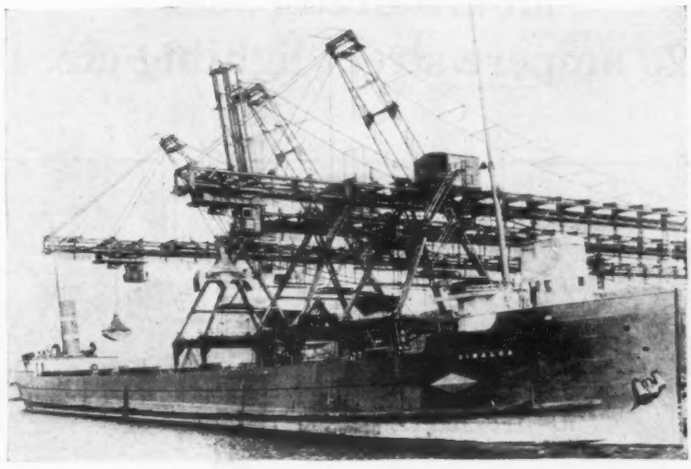
ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

L. W. W. MORROW, *Editor*

FRANK R. INNES
Western Editor
520 N. Michigan Ave.
Chicago
H. S. KNOWLTON
New England Editor
1427 Statler Bldg.
Boston
WALTER C. HESTON
Pacific Coast Editor
883 Mission St.
San Francisco
PAUL WOOTON
Washington
Correspondent
National Press Bldg.
Washington

JAMES H. RUDD
Publishing Director



AUGUST 16, 1930

Contents Copyrighted, 1930, by McGraw-Hill Publishing Company, Inc.

VOLUME 96 . . . NUMBER 7

News of the Industry 283

20,000-Kw. Plant Attains 15,923 B.t.u. per Kw.-Hr. 294
By JOHN W. MIKELS, *Ohio Edison Company*

Dual-Drive Generator Avoids Shutdown 299
By F. M. ROBERTS, *General Electric Company*

Factors in Residential Consumption 301
By P. G. DINGLEDY, *Pennsylvania-Ohio Power & Light Company*

Polyphase Power Factor Recorded by New Meter 305
By L. J. LUNAS, *Westinghouse Electric & Manufacturing Company*

Electrical Switzerland 308
By L. W. W. MORROW

Diverting Direct Strokes 313
By A. E. SILVER, *Electric Bond & Share Company*

Editorials 291
Municipal Plants Decline in Wisconsin 297
Neutral Ground Current Not Sum of Individual Currents .. 298
Developed Water Power Approaches 14,000,000 Hp .. 300
Cathode-Ray Oscillograph Without Glass Parts 303
A Solution to the Problem of Bunched Leads 303
New Speed Control for A.C. Motors 304
Arc-Welded Boilers Not Far Off 306
A Steel Mill Viewpoint on Adequate Lighting 307
Distribution Changeover Without Interruptions 311
Reverses Refrigeration Process for House Heating 315
Financial and Statistical 319
New Equipment Available ... 326
Business Facts for Electrical Men 327

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

JAMES H. MCGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. MCGRAW, JR., Vice-Pres. and Treas.
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
HAROLD W. MCGRAW, Vice-President
H. C. PARMELEE, Editorial Director
C. H. THOMPSON, Secretary

CABLE ADDRESS: "MACHINIST, N. Y."

Published weekly. $5 per year. 25 cents per copy. Entered as second-class matter, January 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Member A.B.C.
Member A.B.P.

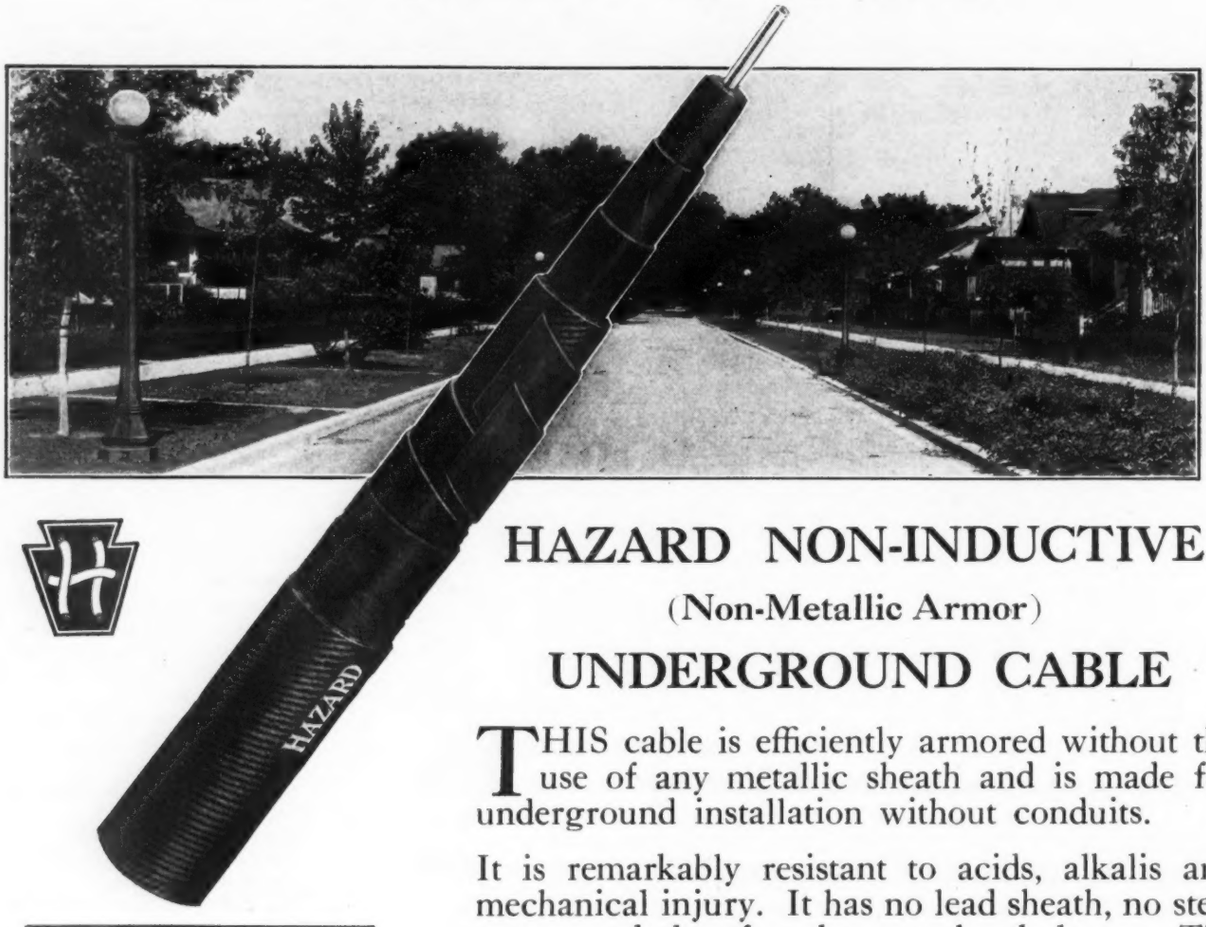
NUMBER OF COPIES PRINTED THIS ISSUE, 18,330

NEW YORK District Office, 285 Madison Avenue
WASHINGTON, National Press Building
CHICAGO, 520 N. Michigan Avenue
PHILADELPHIA, 1600 Arch Street
CLEVELAND, 501 Guardian Building
ST. LOUIS, 1556 Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
BOSTON, 1427 Statler Building
GREENVILLE, S. C., 1201 Woodside Building
DETROIT, 2-257 General Motors Building
LOS ANGELES, 632 Chamber of Commerce Bldg.
LONDON, 6 Bouverie Street, London, E. C. 4

HAZARD

NON-INDUCTIVE

an armored cable
for 20 ampere street lighting circuits



HAZARD NON-INDUCTIVE

(Non-Metallic Armor)

UNDERGROUND CABLE

THIS cable is efficiently armored without the use of any metallic sheath and is made for underground installation without conduits.

It is remarkably resistant to acids, alkalis and mechanical injury. It has no lead sheath, no steel armor and therefore has no sheath losses. The conductor may be economically loaded with full assurance of long life and uninterrupted service. Its light weight saves freight and handling charges and makes it easy to install.

Send for sample and complete information.

Hazard Parkway Cable can be purchased from any Westinghouse District Office or Agent-Jobber. They will gladly supply any desired information either on Hazard Cable or on complete lighting installations.

HAZARD INSULATED WIRE WORKS

Division of The Okonite Company

WORKS: WILKES-BARRE, PA.

NEW YORK	CHICAGO	PHILADELPHIA	PITTSBURGH	ST. LOUIS	BOSTON
ATLANTA	BIRMINGHAM	SAN FRANCISCO	LOS ANGELES	SEATTLE	DALLAS

ELECTRICAL WORLD

for the Week Ending

August 16, 1930

Electric cars on main Pennsylvania line

Drought continues as hydro menace

Stroke diverters for tower lines

Roosevelt appoints St. Lawrence board

—GOVERNOR ROOSEVELT of New York announces the com-position of the state commission to consider hydro-electric power on the St. Lawrence. Ordinary political job seekers a erconspicuous by their absence.

—CONTINUATION of drought forces Louisville to shut down and Susquehanna plants and Martin Dam to minimize output. Degree of interference with hydro still in doubt, lowest steam flow normally coming in fall.

—HEATING by electricity may be 500 per cent efficient. Motor-operated heat pump working on refrigerating principle opens new field for development.

—HYDRO installations in the United States rated at 100 hp. or over total 13,807,778 hp., latest Geological Survey figures show. Increase in 1929 only 1.7 per cent, but 800,000 hp. will be added this year.

—RAILROAD electrification has another thing to boast as the Pennsylvania places passenger-type electric locomotives in service on Philadelphia-Trenton run as operating link in eventual New York-Washington plan.

—RUSSIA orders five more 77,500-kva. waterwheel-driven generators for Dnieper development. General Electric participates further in hydro work for the Soviets.

—SWITZERLAND continues to lead in electrical development and prospers accordingly. Off-peak business eagerly sought and developed largely on water-heater basis.

—LIGHTNING protection follows new idea. Pennsylvania Power & Light Company superimposes 40-ft. creosoted yellow pine poles on transmission towers for supporting stroke-diverting cables.

NEWS OF THE WEEK

University of Virginia Forum Discusses Utility Questions

PUBLIC utilities figured prominently before recent sessions of the Institute of Public Affairs organized for purposes of discussion by the University of Virginia, Charlottesville,

Julius T. Muench, city counselor of St. Louis, referred to the limitations put upon utility regulation by court decisions. Mr. Muench declared that the long line of decisions ending with the Supreme Court ruling in the O'Fallon rate case, establishing the theory of rates based on present replacement value of utilities rather than on the capital invested, runs directly contrary to public interest.

"The utter wastefulness and extravagance of a renewed valuation every time an application for a change in rates is made is one of the worst features of present-day utility regulation," the speaker said. "If the capital invested were used as the basis for the return, as Justice Brandeis proposes, then it is evident we should be dealing with facts and figures rather than with estimates and guesswork. What the public needs is utilities that will render the most efficient service at the lowest possible rates of charge. What the public actually gets, in many cases, is a utility operated primarily with a view to its financial exploitation. What the utilities are entitled to is a fair return on the capital fairly invested."

At another session of the institute public versus private ownership of the power industry was on the carpet, and the views of Prof. James C. Bonbright of the Columbia University School of Business were challenged by W. J. Hagenah, vice-president of the Byllesby Engineering & Management Corporation of Chicago, and A. W. Higgins, president of the Seaboard Public Service Corporation.

Professor Bonbright said that decisions could not be based upon supposedly eternal principles, but that he believed the reasons for government operation and ownership of the great hydro-electric developments such as Boulder Dam, Muscle Shoals and the St. Lawrence River were "so preponderant that the wisdom of choosing in its favor is beyond reasonable doubt."

The high proportion of capital charges involved in hydro-electric development increases the advantage of public ownership because it makes it important to keep returns on capital down to a minimum, Professor Bonbright said. The advantage possessed by the government, he admitted, "would doubtless be present even if private companies were now subject to a really effective control of their own rates."

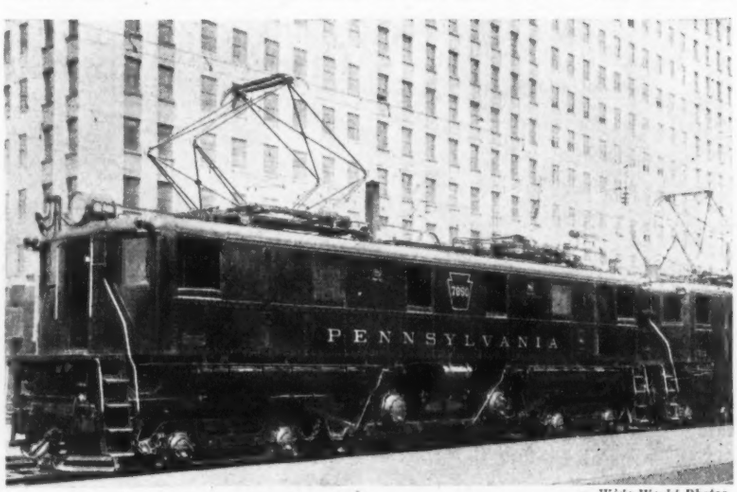
Mr. Hagenah said that discussions of this sort often overlooked the fact that with the increasing efficiency of steam-power projects water power was diminishing in importance and that the smaller projects "will either have to be abandoned or merged into larger systems." This view was supported by Mr. Higgins, who said his company had several small power projects throughout the South that it "would be entirely willing to hand over to the government."

On Tuesday, August 12, Preston S. Arkwright, president Georgia Power Company, took part in a discussion on the economic and industrial development of the South, asserting that although 98 per cent of the electric power in that territory is generated by privately owned plants it has the lowest average rates of any part of the country. He offered this as an argument against government-operated utilities.

A representative of radical sentiment, Oscar G. Villard, editor of the New York *Nation*, declared that a demand

▼ ▼ ▼

PENNSYLVANIA LOCOMOTIVES ON THE RAILS



—*Wide World Photos.*

Another step in the main-line electrification of the Pennsylvania Railroad was taken on August 8, when passenger locomotives of the type to be used eventually in the run from New York to Washington were put on the rails between Philadelphia and Trenton. These Westinghouse locomotives, the most powerful of their type, have a capacity of 2,120 hp. when moving at 56 miles an hour.

for a commission in Washington to control all power companies and public utilities, with similar powers to those of the Interstate Commerce Commission, is due to the belief that 'if something is not done to check the combinations going on in this field there will soon be one company not only controlling all the power plants and public utilities in the United States but all those between the Rio Grande and the Straits of Magellan."

Martin J. Insull, president of the Middle West Utilities Company, defended mergers and the holding company and held that the latter should be free from any form of governmental supervision. Mr. Insull's address will be printed in part in an early issue.

On the following day Mr. Insull debated private ownership of utilities with Norman Thomas of New York, Socialistic leader and presidential candidate of that party in 1928.

▼

St. Lawrence Commission Appointed by Roosevelt

IN ACCORDANCE with the law passed by this year's Legislature, Governor F. D. Roosevelt of New York has appointed five men as members of a commission "to study and report plans for the development and a form of contract for the sale of hydro-electric power to be generated at water-power sites on the St. Lawrence River owned or controlled by the people of the state."

The Governor's appointees, announced by him on Wednesday of this week, are:

ROBERT M. HAIG, chairman; School of Business, Columbia University, New York.

FREDERICK M. DAVENPORT, Clinton; Representative in Congress and professor of law and politics at Hamilton College.

JULIUS HENRY COHEN, New York; counsel to the Port Authority of New York and New Jersey.

THOMAS F. CONWAY, Plattsburg; former Lieutenant-Governor.

SAMUEL L. FULLER, New York; banker and member of the firm of Kissel, Kinnicutt & Company.

Governor Roosevelt said there was no politics in the choice and pointed out that Mr. Davenport is a Republican, Mr. Cohen an independent Democrat, Mr. Conway a Democrat, Mr. Fuller a Republican and Professor Haig an independent. He also said that he had urged former Governor Alfred E. Smith to join the commission, but that Mr. Smith was unable to spare the necessary time from his business interests.

The law says that the commission shall report to the Governor and Legislature not later than January 15, 1931.

The commission is expected to organize within a week. Accompanied by the Governor the members will make a personal inspection of the Long Sault Rapids in the St. Lawrence River on August 31 and September 1.

In this connection it may be noted that the State Department at Washington has requested the Canadian government to fix a date for a meeting of the Joint International Board of Engineers to consider the two-stage St. Lawrence plan submitted in July by the Canadian section.

▼

New York Edison Rate Testimony August 21

ALTHOUGH some of those opposing the proposed residential rate of the associated Edison companies in Greater New York—5 cents a kilowatt-hour plus a 60-cent service charge—desired a longer postponement, Chairman Milo R. Maltbie of the Public Service Commission, at the preliminary hearing on Tuesday of this week, declared himself opposed to any policy involving delay and set August 21 as the date for hearing the first testimony. On that day Judge W. L. Ransom, counsel for the companies, will submit evidence in support of the suggested change.

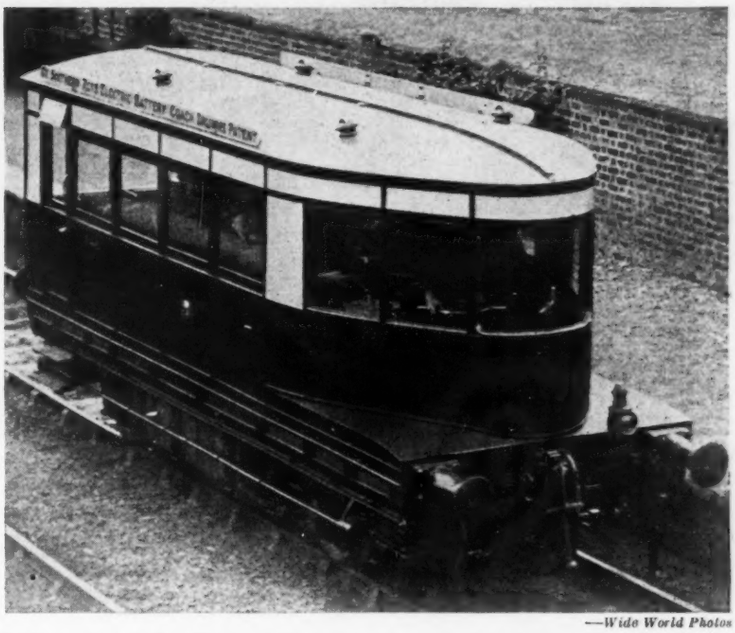
Various civic and community organizations opposed to the service charge were represented on Tuesday and will later file testimony or cross-examine the company's experts. Arthur J. W. Hilly, Corporation Counsel of New York City, who did not join in the request for adjournment, announced his intention of fighting for a flat charge of 5 cents or less for the small residential consumer, without the service charge, and with the rates grading down to 2 cents for large power consumers.

▼

To Build Second Section of State Line Plant

PRELIMINARY construction on the second section of the State Line Generating Company's station on the shore of Lake Michigan at the Indiana-Illinois state line in Hammond, Ind., has commenced, officials of the company

DRUMM BATTERY INTERESTS FREE STATE



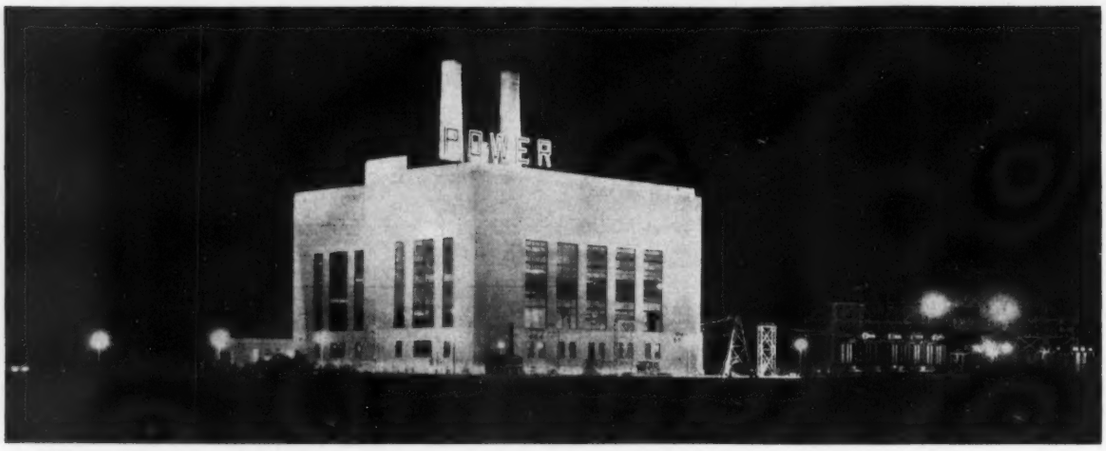
—*Wide World Photos*

FINAL tests of the Drumm battery, the invention of a young Irish engineer, for which great claims are made and in which the Free State government is intereste, were a recent report said, about to be held on the Great Southern Railway of Ireland. A special coach had been prepared for the purpose. The Drumm battery is confidently expected in Ireland to revolutionize the existing system of electric battery charging, and if it is successful, it is hoped that the electrification of the Irish Free State railroads at a comparatively low cost will become feasible.

Above is shown the specially constructed coach driven by this "low-resistance alkaline battery of robust construction," which is said to have a voltage higher than any other alkaline charger and to be rechargeable in a few minutes.

▼ ▼ ▼

EL PASO GENERATING PLANT BECOMES CITY SHOW PLACE



Floodlighting of the Rio Grande power station and grounds has been completed by the El Paso (Tex.) Electric Company. Twenty-one 1,000-watt floodlamps in five banks, mounted on concrete bases at the ground level, illuminate the front and side of the main building. Six 500-watt G.E. floodlamps, installed on the roof, illuminate the stacks. The neon sign, "Power," is in double-tube 12-ft. letters of red. The installation, demanding approximately 31 kw., is in operation every night from dusk until 11 o'clock.

▼ ▼ ▼

announce. Generating units Nos. 2 and 3, with a total rating of 257,000 kw., will be installed in this section, bringing the total station capacity to 465,000 kw. Unit No. 2, with a capacity of 132,000 kw., which will be placed in operation in 1932, is being built by the General Electric Company. Unit No. 3, rated at 125,000 kw., to go into operation in 1933, is being constructed by the Allis-Chalmers company. Both units will be operated at 1,200 lb. steam pressure. Six boilers will supply the steam.

An addition to the station building, on the south side, 380 ft. long, 210 ft. wide and about 100 ft. high, will double the size of the present structure. It will be of steel and brick, corresponding in architectural design with the present building, and will contain the turbine room for the second and third units, a boiler room and an operating room.

The State Line Generating Company will have an eventual capacity of at least 1,000,000 kw., to be apportioned among the four Insull companies it was built to supply.

▼

N.E.L.A. Indorses A. D. Curtis Award

BETTER illumination in commercial buildings will be stimulated by the Augustus D. Curtis award, to which C. E. Greenwood, commercial director of the N.E.L.A., calls attention in a recent communication to commercial executives of member companies. Mr. Curtis, who is the head of Curtis Lighting, Inc., Chicago and New York, offers a certificate to the company and $500 in gold to the person in the company that shows the greatest contribution to commercial electric lighting in any year, beginning with 1930. Announcement of the winner will be made at the annual convention of the association.

▼

Downtown Columbus May Change to A. C.

TWO million dollars will be expended by the Columbus (Ohio) Railway, Power & Light Company in the next three years in changing its downtown power network from direct to alternating current, according to a letter received by the City Council from Benjamin W. Marr, president of the company. Scores of transformers will be installed, in some cases in wells set in buildings, basements, under sidewalk areaways and in a few cases in the street. Meters and connections also will have to be changed.

The reason for the change, as given by the company, is to avoid the possibility of breakdowns. Since all parts of the city outside of the central downtown district use alternating current, emergency connections could be made more easily under the new plan. The company will carry through the work without incurring any expense to its customers in changing equipment and wiring. The City Council will ask for more complete information.

Lightning Tests Made on Commercial Transformers

FOR the first time in electrical history full lightning tests were made on August 8 and again on August 12 on commercial transformers. These transformers were built at the Pittsfield works of the General Electric Company for operation on the Fifteen-Mile Falls 220-kv. transmission line of the New England Power Company, and the tests were conducted under the direction of F. W. Peek, Jr., in charge of the high-voltage laboratory of the company.

Three-million-volt lightning waves, used in making the tests, were conducted from the laboratory over a short line to the testing department and repeatedly applied to the 13,000-kva. transformers immediately after the commercial tests were completed. The transmission-line insulation arrangement was made to compare with operating conditions—fifteen shielded units on the main line and fourteen units at the transformer. The lightning waves were of a type to produce the severest stresses and covered a range of time varying from one-half of a microsecond front to 80 microseconds tail. It was found impossible to break the transformers down.

The transformers were of the nonresonating type described by K. K. Palueff in his paper entitled "Effect of Transient Voltages on Power Transformer Design," presented at the midwinter A.I.E.E. convention in January, 1929. They were designed for the standard A.I.E.E. 3.46 test.

Unprecedented Drought Conditions Hit Hydro Plants, but Service Goes On

FEW statistics have been needed to convince observers within the wide areas affected that the drought of 1930 is the most widespread so far in American history. Starting as early as last November in some regions and not until February in others, the drought has grown to cover most of the United States east of the Rocky Mountains with the exception of the extreme Southwestern States and parts of New England where rainfall is normal or above. The Pacific Northwest also has been dry for the second consecutive year, though the West Coast otherwise is normal and rainfall in the southern Rockies unusually high.

None the less, the degree of interference with generation of electricity has been notably small, owing to the policy pursued for many years by the light and power companies in building ample steam reserve plants and flinging far their interconnected transmission networks. Normally in most districts the lowest point in stream flow does not come until early or late fall, but there is, of course, the possibility of copious rains before then.

From a summary by states prepared by a Washington representative of McGraw-Hill publications and based mainly on information collected under the direction of Dr. N. C. Grover, chief hydraulic engineer for the United States Geological Survey, the following facts are excerpted:

Arkansas.—Streams now lowest during period of continuous record 1922-30. Conditions indicate further recession.

Alabama—Rainfall first six months this year a minimum record, but general conditions not so severe as in 1925 in most parts of region. The Alabama Power Company estimates its Martin Dam reservoir 2 ft. below normal but 2 ft. to 5 ft. higher than it would have been if operating in 1915, 1914 or 1904.

Georgia and Florida.—Florida rainfall above normal. Georgia has some drought, but not so bad as 1925. Georgia Power Company's Burton Reservoir 2 ft. below computed normal, but 2 ft. above 1927, 43 ft. above 1925 and 3 ft. above 1904.

Tennessee.—Rainfall deficient since January; three-quarters normal to June and one-quarter to one-half normal since. Streams still 25 to 50 per cent above 1925.

North Carolina.—Streams still above 1925 level except along Virginia border.

Virginia.—Streams 20 to 25 per cent higher than in 1925.

West Virginia.—Smaller streams totally dry; larger streams let some run-off down. Rivers vary from one-tenth to two-thirds normal.

Indiana and Illinois.—Streams low and going lower, but there are no extensive hydro developments.

Missouri.—In northern part of state rainfall not much below normal; in southern part very dry, with streams 20 to 40 per cent higher than minimum reached September, 1925.

Texas.—Most streams substantially above record minima, though some smaller streams are close to lowest flows hitherto recorded.

Minnesota.—Drought not serious. Stored water in all reservoirs below normal.

Wisconsin.—No serious drought.

Pennsylvania, Maryland and Delaware.—York Haven and Conowingo power plants on Susquehanna River at lowest during their operating period. Delaware River July minimum comparable to July, 1926, but lower stages expected later in season. Potomac River down to 1,100 sec.-ft., minimum record being given as 800 sec.-ft. One Maryland village reports being without electric light because local plant cannot operate.

New York.—No shortage of water reported by power plants on Hudson River, which is well regulated. Most of state probably in fair condition.

Connecticut.—No serious drought. Run-off conditions much better than last summer.

Massachusetts, Vermont and New Hampshire.—Conditions good in northern Vermont and New Hampshire. In Massachusetts and southern New Hampshire drought conditions are severe.

Maine.—No drought; run-off normal or above.

Gorgas Steam Plants Come to the Rescue

THOUGH it took more than 99 per cent of the available power of Wilson Dam at Muscle Shoals in July and expects to continue capacity takings, the prevailing drought forced the Alabama Power Company to put its Gorgas steam plant in the Warrior coal fields in readiness by August 15 for service to counteract the lack of rainfall in the watersheds of the Coosa and Tallapoosa Rivers.

Beginning with June 13, the company used 81 per cent of the available flow of the Tennessee at Wilson Dam for the rest of that month and more than 99 per cent in July. In addition, it operated its run of river plants to full capacity and drew heavily on the stored waters of Martin Dam. The turning over of the 60,000-kw. unit of the Gorgas No. 2 plant, the testing out of boilers and inspection of auxiliaries went forward rapidly, and everything was in readiness by the middle of August for full-load generation. The three other units at Gorgas, in plant No 1, which total 75,000 kw., were also put in readiness, and should the drought which has gripped the Southeast since early summer continue unabated, the operation of other steam units may be necessary.

Nearly 150,000 tons of coal is in storage on the yards adjacent to the Gorgas plants. This is sufficient for 166 days' operation of plant No. 2 at 900 tons a day, for 100 days' operation

▼ ▼ ▼

HYDRO-ELECTRIC DAM ON THE ZSCHOPAU

—P. & A. Photos

At Zschopau, Saxony, on the river of the same name, this dam has recently been erected, giving evidence once more of how wide-awake Germany is in the exploitation of her hydro-electric resources.

PUBLIC AND PRIVATE UTILITY MEN FRATERNIZE

Back row—J. R. Aikman, Winnipeg Hydro-Electric System; J. R. Rossetti, Public Service Company of Northern Illinois; F. H. Martin and E. V. Caton, Winnipeg Electric Company; F. W. Maiby, Winnipeg Hydro-Electric; F. R. Innes, Western editor ELECTRICAL WORLD; *M. C. Gilman, Winnipeg Electric; W. P. Brereton, city engineer. Front—F. Furgeson, secretary to Mayor of Winnipeg; A. E. Parker, Winnipeg Electric; L. Smith, Winnipeg Hydro-Electric*

The fact that a privately owned and a municipal electric utility are in competition in the city of Winnipeg does not prevent amicable relations between members of the two organizations. This party recently inspected the construction of the Seven Sisters project of the Winnipeg Electric Company.

▼ ▼ ▼

of plant No. 1 at 1,500 tons a day and for 62 days' operation of both plants at 2,400 tons a day. Nearly four times as much power has been purchased from the government at Muscle Shoals this year as in 1929, company officials say. The record up to August 1 came to 159,979,000 kw.-hr. against 40,657,000 kw.-hr. the previous year.

▼

Stream-Flow Conditions in North Carolina

WIDESPREAD deficiency in rainfall this year has led the North Carolina Department of Conservation and Development to make detailed studies of several river basins, and its findings as of June 30 have just been issued. Reports will hereafter be published monthly.

For the state as a whole rainfall from November, 1929, to June, 1930, was 5.95 in. below normal, or 12 per cent. In the Hiwassee basin the deficiency in percentage was 17.2, in the French Broad 38.3, in the Linville 27.2, in the Yadkin 23.3, in the Cape Fear 9.9, in the Neuse 9.1, in the Roanoke 23.6, and in the Tar basin, 8.1.

Percentages of run-off as compared with normal are a little less formidable. In two instances they show an increase —the Hiwassee basin one of 2.6 per cent and the Tar one of 6 per cent. Decreases are: French Broad, 14.9; Linville, 22.9; Neuse, 14.4, and Roanoke, 20.7, figures for the Yadkin and Cape Fear basins being not yet available.

For the Catawba basin the division has fewer data than for any other stream, owing, the department says, to the fact that the Duke Power Company does not assist in the maintenance of stream-gaging stations. That company reported, however, that on July 22, with less than half of its ample steam capacity in service, it was able to meet all of its load demands without further depletion of its reservoirs.

On the whole, streams from Murphy to Bryson City are holding up well, says the department. From the French Broad to the Cape Fear inclusive streams are already down to or below the minimum discharge of record. From the Neuse to the coast streams are in better condition as one proceeds east, except for the Roanoke, which is approaching the minimum discharge of record.

▼

Output from Ohio River at Louisville Suspended

SEVERE drought in the Ohio Valley has resulted in suspending the output of energy from the combined power and navigation dam of the federal government and the Louisville Hydro-Electric Company, in the Ohio River at Louisville. The Kentucky Utilities Company has held such water as it has in reserve at the Dix River dam for possible use in the event that some of the steam plants find themselves short of water supply. The Kentucky River hydro plant has also been inoperative, owing to lack of water in that stream. The drought in Kentucky is so severe in some cities that water is being rationed.

▼

New Application for West Virginia Sites

AN AMENDED application including two proposed water-power developments instead of one, in three southern West Virginia counties, on the New River and tributaries, at a total estimated cost of $23,000,000 and involving 199,000 hp., was filed with the Public Service Commission of that state on July 31 by the West Virginia Power Company of Charleston. No date was set for a hearing.

The proposed developments will be known jointly as the Bluestone project and will combine plants to be known as the Hinton development and the Bull Falls development in Summers, Mercer and Monroe Counties and extending into Giles County, Va.

The West Virginia Power Company, a subsidiary of the Appalachian Electric Power Company, filed an application in 1924 for a single development on the New River to be known as the Bluestone project and to be about 14,000 ft. from the mouth of the Bluestone River in Summers County. The application was not acted upon by the commission.

The Hinton development, as described in the amended application, embraces a dam approximately 43 ft. high, a reservoir of about 20,500 acre-ft. and a power station with an installed capacity of 31,000 hp. The estimated cost would be $6,171,000.

The Bull Falls development, which would follow the other, 8.8 miles upstream from the Hinton site, would include a dam approximately 125 ft. high, a reservoir with storage capacity of about 125,000 acre-ft. and a power station with an installed capacity of 168,000 hp. The cost is estimated at $16,750,000

The company said that it was proposed to develop at least the same head by means of the two dams and power stations that had been contemplated by one dam and one power station in the original application. The project contemplates complete utilization of the available head within the portion of New River affected. It will not interfere with development of the water power on any other portion of New River.

Legal proceedings to upset the license granted on Cheat River by the West Virginia Public Service Commission to the West Virginia Power & Transmission Company have been begun, the appellants, headed by former Governor A. B. White, attacking the constitu-

tionality of the state water-power act and claiming that the commission had failed to make adequate inquiry or to safeguard the interests of the people. September 8 has been tentatively set as the date for a hearing in the Kanawha County Circuit Court.

▼

Klamath River Plants Projected in Oregon

PROVIDED that the Federal Power Commission acts favorably upon the application of the California-Oregon Power Company for a license to develop 70,000 hp. at what is known as the Grant power site in Klamath County, Ore., the State Engineer announces that his office will issue the necessary permits immediately. Action has been delayed by an opinion of the Oregon Attorney-General, now modified. In the meantime the California-Oregon Power Company has filed an additional series of five applications, showing that the utility contemplates the development eventually of approximately 245,420 hp., at an estimated cost of $27,500,000, at five different points along the stream from the Grant site to the California-Oregon line, a distance of 15 miles.

The Klamath Falls Irrigation District has filed two applications with the state for permits to appropriate a total of 4,000 sec.-ft. of water from the Klamath River for the purpose of developing 28,500 hp. The proposed points of diversion are 6 miles southwest of Klamath Falls and approximately one mile apart. Before this development may proceed it will be necessary for Congress to enact enabling laws, as the application involves lands which belong to the government.

▼

Coming Meetings

Association of Electragists International—Hotel Schroeder, Milwaukee, Aug. 18-20. L. W. Davis, 420 Lexington Ave., New York.

Institute of Radio Engineers—King Edward Hotel, Toronto, Aug. 18-21. H. P. Westman, 33 West 39th St., New York.

International Association of Electrical Inspectors—Northwest Section, Bellingham, Wash., Aug. 25-27. F. D. Weber, 414 Lumbermen's Bldg., Portland, Ore. Western Section, Congress Hotel, Chicago, Sept. 15-18. W. S. Boyd, 175 Jackson Blvd., Chicago. Eastern Section, Pittsfield, Mass., Sept. 22-24. R. Walker, 85 John St., New York.

American Institute of Electrical Engineers — Pacific Coast convention, Portland, Ore., Sept. 2-5; Middle Eastern District, Philadelphia, Oct. 13-15; Southern District, Louisville, Nov. 19-22. F. L. Hutchinson, 33 West 39th St., New York.

Pennsylvania Electric Association—Bedford Springs, Pa., Sept. 3-5. Harold A. Buch, Telegraph Bldg., Harrisburg, Pa.

Maryland Utilities Association—Chesapeake Bay cruise to Jamestown and Yorktown, Va., Sept. 11-13. D. E. Kinnear, 803 Court Square Bldg., Baltimore.

Empire State Gas and Electric Association—Saranac Inn, N. Y., Sept. 18 and 19; Meter Section, Watertown, N. Y., Oct. 9 and 10. C. H. B. Chapin, Grand Central Terminal, New York.

Great Lakes Division, N.E.L.A.—French Lick Springs, Ind., Sept. 25-27. T. C. Polk, 20 North Wacker Drive, Chicago.

American Electrochemical Society — Hotel Statler, Detroit, Sept. 25-27. C. G. Fink, Columbia University, New York.

National Safety Council—Pittsburgh. Sept. 29-Oct. 4. W. H. Cameron, 20 North Wacker Drive, Chicago.

New England Division, N.E.L.A.—New Ocean House, Swampscott, Mass., Sept. 29-Oct. 1. Miss O. A. Bursiel, 20 Providence St., Boston.

Illuminating Engineering Society — Hotel John Marshall, Richmond, Va., Oct. 7-10. E. H. Hobbie, 29 West 39th St., New York.

Rocky Mountain Division, N.E.L.A.—Franciscan Hotel, Albuquerque, N. M., Oct. 20-22. O. H. Weller, Public Service Co. of Colorado, Denver.

National Electrical Manufacturers' Association — Chamberlain-Vanderbilt Hotel, Old Point Comfort, Va., Oct. 20-24, A. W. Berresford, 420 Lexington Ave., New York.

▼

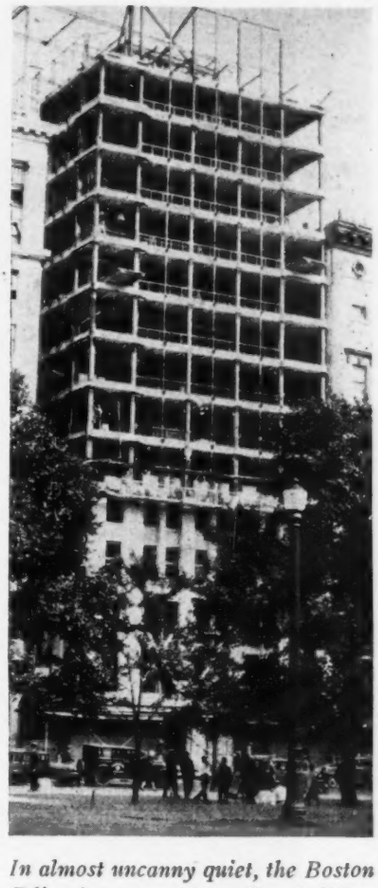
Five More Big Units for Soviet Government

FIVE more large hydro-electric generators are to be added by the Soviet government to the four already under construction in America for the Dnieper River development in the Ukraine. The Dnieper River units will supply power to Dnepropetrovsk and the southern part of the Soviet territory.

The first four of these generators are being built at the Schenectady works of the General Electric Company, and the fifth will also be entirely constructed there. The remaining four will be manufactured jointly at Schenectady and in Russia, with assembly of the units in the latter country. The generators, rated at 77,500 kva. each, will be, the manufacturer states, the largest waterwheel-driven generators of any type ever built, the next largest, those at Niagara Falls, being rated 65,000 kva. each. The Pittsfield works of the General Electric Company are building 21 26,000-kva. transformers and the Philadelphia works the switchgear equipment for six units.

Negotiations for both the original four generators and the added five were completed with the International General Electric Company by the Amtorg Trading Corporation of New York. The nine water turbines, to operate under a head of 123 ft., are being supplied by the Newport News Shipbuilding & Dry Dock Company. Hugh L. Cooper & Company, New York, are the consulting engineers on the construction of the dam and power station. The first generator is scheduled for shipment next April.

SPEED WITHOUT NOISE



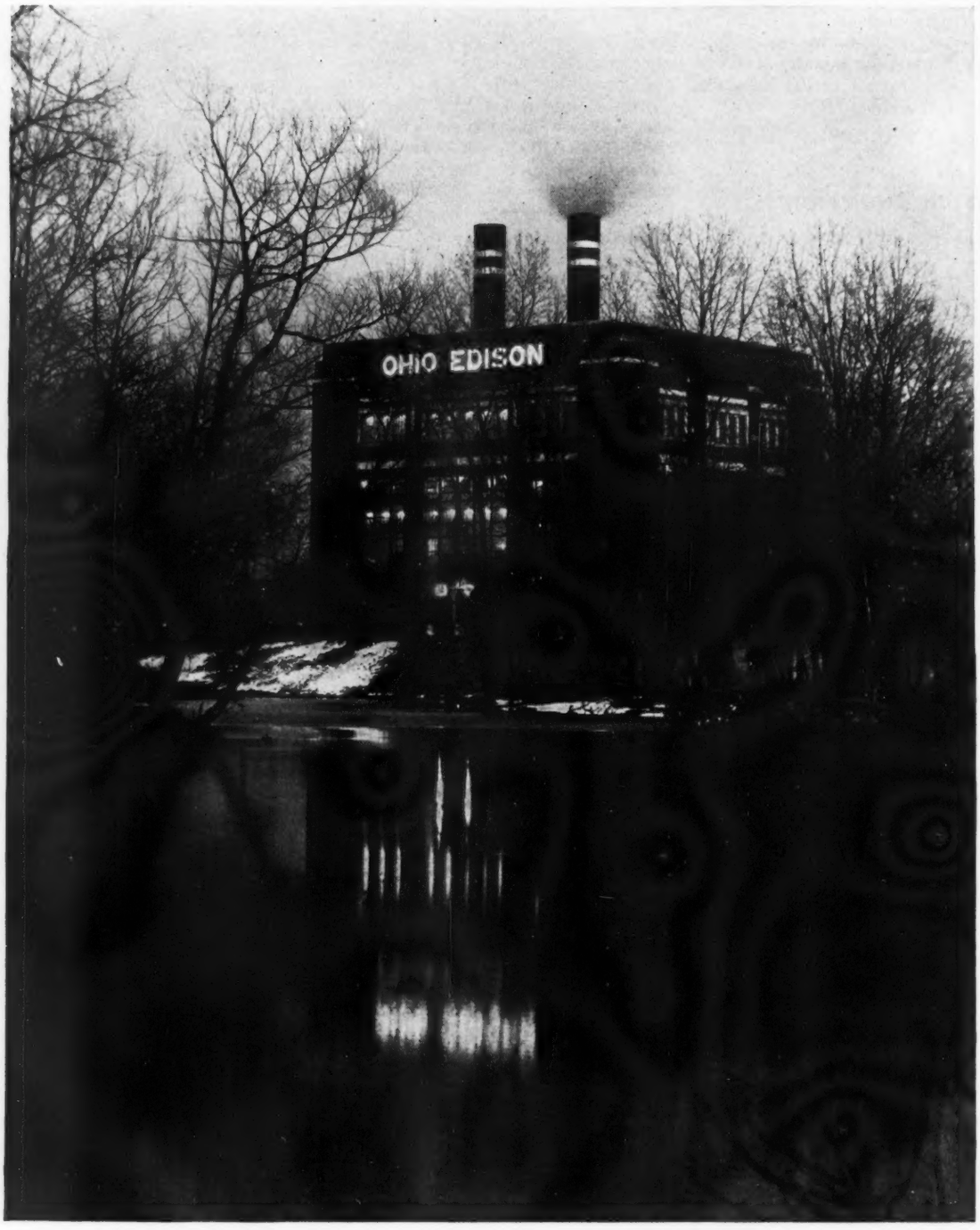
In almost uncanny quiet, the Boston Edison's arc-welded office building rises into place among the Hub's business structures.

▼

"Power Trust" Shows Fine Italian Hand in Utah

COLORADO, Wyoming, Utah and New Mexico, the four upper Colorado River Basin states, are to send representatives to a meeting to be held in Denver on August 25 to meet a representative of the Reclamation Bureau and present data as to the respective water requirements of their states as a preliminary to the drafting of a treaty for the final allocation of the waters of the Colorado.

On this circumstance the Denver *Post* hangs a story of the "interesting if true" variety to the effect that although Colorado, Wyoming and New Mexico have been ready with their data for many months, Utah is still unprepared, the reason being that the "power trust" has in devious ways prevented any assembling of data in the last-named state in the hope of first getting huge appropriations for itself, notably at Flaming Gorge, on the Green River.



Beauty and Economy at Mad River Station

THIS STATION, which is rated at only 20,000 kw., during the last year improved on its initial economy with a record of 15,923 B.t.u. per kilowatt-hour despite the fact that it is not favored with a base load. For records attained and some of the things done to obtain them see page 294.

EDITORIALS

L.W.W.MORROW
Editor

No Time for Armchairs

"BUSINESS is bad" is an expression that causes more disaster from its psychological effects than it does because it states a fact. It seems to justify laziness, complacency and inertia and stifles initiative and building. It instills the counsel of fear into management and puts a premium on wasting dollars to save pennies.

Too frequently utility executives have felt the results of the "business-is-bad" psychology. Too many financiers assert that money spent for sales is waste—it is cheaper and better to let the buyer come to the utility. Other financiers and stockholders say that inducement rates merely afford an excuse to give more energy to customers for the same or less money. Then, again, another group is hypnotized into saying that, irrespective of profit, it is the duty of utilities to give low rates and increased service, and as a result fear arises in the minds of stockholders and investors. Still again, there may be an economy program whereby salaries are cut, sales and operating expenses are reduced, construction is stopped and all forward-looking investments are curtailed. Many and dark are the mental clouds that are created by "business is bad."

Of course, these things are silly, even if they are human. Business is not bad in the utility industry, except as a few per cent variation can be called bad, and any sane analysis of utility prospects in the future shows stability and growth equal to those of the past. A slowing up in rate of increase for one year will be offset by an equally abnormal rate of increase in another year.

Wise utility men will fight against the "business-is-bad" psychology. It is to the interest of their customers and their stockholders that slack times be utilized for money making as well as boom times. Intelligently studied, a slow period in the utility business can be used to plan ahead and reorganize and to build and sell effectively and economically. "Get more business and get ready for more business" should be the policy substituted for that of standing still and looking at the dark clouds.

Gaging the Market for New Securities

AN ATTEMPT is being made by the Investment Bankers' Association to find a means to determine the volume of undigested securities in the market at any given time. The study is particularly timely because of the part played by unsold securities in the market break and in its recovery, because of the increasing volume of new capital required yearly, and also, especially in the utility industry, because of the increasing size of individual issues arising out of consolidations.

Last year new capital and refunding requirements in this country exceeded ten billion dollars. The power and light companies alone require up to a billion and a half yearly. This year to date total flotations are about 40 per cent greater than for the corresponding period of 1929. Fifteen new issues this year have each amounted to $20,000,000 or more, and several exceeded $50,000,000.

All this emphasizes the urgency of having some adequate gage of the market's receptiveness at any time—an important factor in the price and salability of a new issue. To the layman, at least, the lack of any such accurate check seems remarkably haphazard.

It is safe to assume that the utilities, their bankers and the public indirectly would all benefit from a more accurate knowledge of market receptiveness. Information alone may not place any

limit upon new issues, but it certainly would be a guide to those floating the larger issues and would tend to make the market "load" more even.

Miniature Control Switchboards

A CASUAL review of switchboard history will at once disprove the statement often made that standardization blocks progress. There is hardly anything more standardized than the switchboard field, and yet it shows probably more steady progress than any other field. The modern steel panel, with its small, clear-scale, accurate instruments, compared with the old large marble board, is as man to ape. And even this modern steel board is as ape to man when compared with the new miniature control board described at the Toronto convention of the A.I.E.E.

This new-type miniature switchboard is not to be confused with the supervisory control board; rather is its control system direct, containing no relay chains. It employs 55 volts for control and instruments, and the current carried by the control wires is a matter of milliamperes. Thus one telephone cable can take care of the control of a whole switching structure or a whole outdoor substation. What a simplification, what a saving in conduit and cable, and what improvement in operation! No more racks full of conduit and control cables. No more running back and forth along a long board to find out which switch tripped. No more jumping from panel to panel to synchronize. No more craning the neck to read an instrument. The operator can remain seated while controlling and supervising a large power house. The heavy currents required for solenoids are taken care of in the usual manner by local control buses at the breakers. The relays and recording meters are located at the breaker in the enlarged solenoid house. The instruments are square and very small, but their scales are clearer than those of the giant instruments of old.

Strictly speaking, there are no more panels. The whole board is built up of blocks, all of the same size and assembled on light frames. Each instrument is a block and each control switch is a block, and the empty spaces are covered with plates having the same dimensions as the blocks, so that they can be replaced by instruments whenever needed. The danger of operating a wrong switch when switches are so close together can be overcome by making it necessary to operate two switches, a control switch and a master key, before the instrument functions, the operator thus being able to check the manipulation. The whole arrangement is a thing of beauty and utility. Truly, another large feather in the already very feathery cap of the American switchboard designer.

The Concurrent Appliance-Sale Idea Steps Forward

STEP by step the electrical industry is slowly getting away from the idea that the only way to sell electricity to the American home is to "make whoopee" with one appliance at a time. That habit grew out of the fact that through the years important labor-saving devices were put upon the market one after another and each became the latest fad in selling. As the new came into the arena the old went out of mind. Finally came the concurrent-campaign idea in which certain smaller appliances were scheduled to be featured in short sales drives throughout the country.

It was a good idea and the power companies took it up enthusiastically. It sold hundreds of thousands of appliances. It brought many secondary appliances into the limelight. It encouraged many utility companies to do something energetic every month, instead of resting on their oars between the major operations. But it had certain damaging influences also. Through misguided zeal, induced very often by hot competition between manufacturers, many of these campaigns really became high-pressure drives to sell on terms involving unnecessarily long terms, ridiculously small payments or extravagant premiums. Values were depreciated. Dealers could not compete. Trade relations were upset. All this was gradually recognized and in most cities corrected. Two good lessons came out of it, however—that continuous seasonal campaigns are productive and that all varieties of appliances can be sold.

These general simultaneous campaigns have created a difficult problem for the manufacturer,

however, because they have brought very heavy demands for special goods over a very short period and have played hob with production schedules. The manufacturers, therefore, are now urging that the nation-wide concurrent-campaign program be discontinued. They recommend that the power company and all the dealers in each locality conduct their own seasonal campaigns at whatever time seems best on whatever appliances they select and that more effort be made to sell all these appliances throughout the year.

This is sound sense. For people in their homes are not primarily concerned with this appliance or that, but with comfort and labor saving. And housework habits differ in different homes. Some day we know that all new homes will be equipped with all the major appliances built into the real estate—and many of the secondary devices will be considered essential. Meanwhile here is another step in the direction of selling the complete enjoyment of the broad service of electricity.

Steam Turbine Development

FOR the present and for some time to come steam turbines will be used for the major power developments in the world. Consequently all improvements in their design are followed with close interest. But it is not enough to consider only those changes and improvements that have taken place. Engineers must also acquaint themselves with the trends of development and endeavor to foresee advances in order to plan intelligently the extensions to power systems under their direction.

Recent discussions have indicated economic justification of the use of high-pressure turbines both in industrial plants when exhausting to process systems and in central stations where the high-pressure unit exhausts through reheaters into standard turbines built for the relatively lower pressure of the older portion of the plant. Steam pressures from 600 to 1,400 pounds are already used in such units. There are indications that steam pressures will be increased to 2,000 or 2,500 pounds in the near future. High-pressure turbines will be used in rapidly increasing numbers from now on.

For some years past American engineers have regarded 750 deg. F. as the safe limit of steam temperature for turbines. Experience with higher steam temperatures abroad and a better knowledge of the properties of materials that may be used at these higher temperatures have led to a reconsideration of the limiting steam temperature. Plants are projected for 825 deg. F. steam temperature, and there is every reason to believe that no particular difficulties will be encountered in their operation. It is becoming evident that new plants will be planned for even higher temperatures.

Reheating of steam was necessary when steam temperatures did not exceed 750 deg. F., and pressures above 500 pounds were used. Both flue-gas and live-steam reheating have been tried, and the gains possible by each system are now known. The possible use of higher steam temperatures, coupled with the difficulties and complications of reheater operation, have caused some engineers to consider the omission of reheaters. Prof. A. G. Christie in his paper on steam turbines at the recent World Power Conference points out that the heat added on reheat can be utilized much more efficiently than heat added in the boiler. Possibly, in view of this fact, a reconsideration of the use and efficiency of reheating under the new pressure and temperature conditions should be made.

Another factor is the economic rating of turbine casings to provide the lowest power cost for a given set of operating conditions. Few engineers realize the savings that may be effected in first cost by the proper selection of a turbine casing among the various manufacturers' standards.

Finally, base-load turbines appear to have less justification than was formerly believed, since they are so quickly superseded by newer developments. In general it now seems better to buy a turbine with its most efficient load at a relatively low percentage of its maximum rating and so designed that there is little increase in heat consumption from the most efficient stage to full load. The added flexibility and efficiency of such a unit under average operating conditions make it a more desirable and generally, when costs are considered, a more economical unit than a base-load turbine.

These developments are introducing new factors into the problem of turbine selection. Their effect on future station design must be studied.

20,000-Kw. Plant Attains

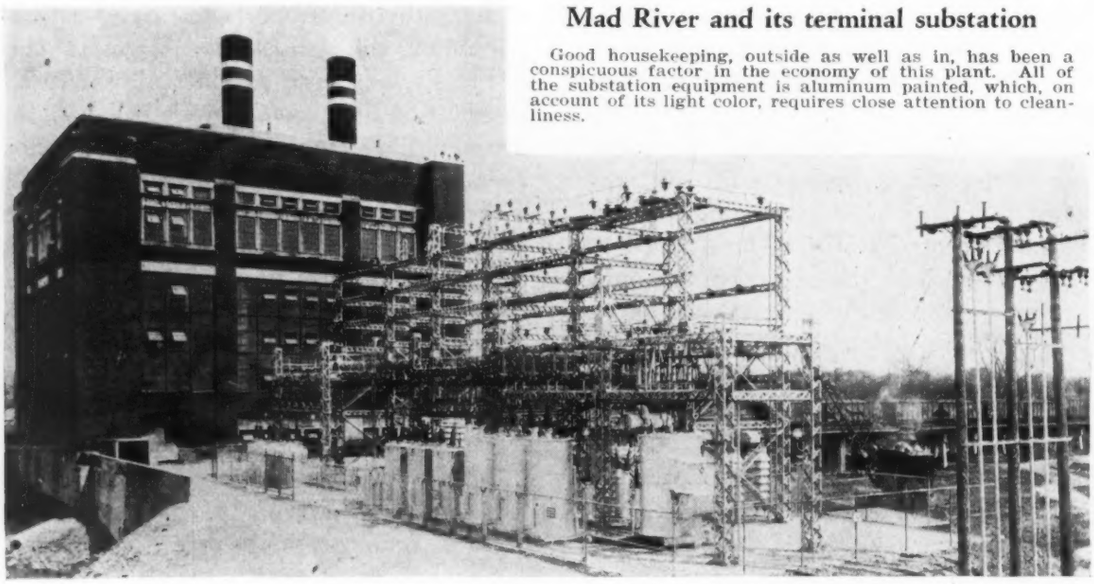
POSSIBLY there are other stations of a size comparable to Mad River that have as good an operating performance as is shown by the records in this article. But here is a plant running under load conditions not particularly favorable to economy that achieves a fuel-to-energy output ratio as low as is reached by many other stations much more pampered as regards load assignment

THREE "betters" and one "lower" combined to give the Mad River station of the Ohio Edison Company a figure of 15,923 B.t.u. per kilowatt-hour delivered in 1929, as against 16,238 in 1928. The "betters" apply to turbine water rate, boiler operation and grade of coal, while the "lower" refers to station power loss. The improvement is less than 2 per cent, but that is a respectable one, because, as every electric utility man knows, power station economy figures are painstakingly whittled down; they are hardly ever slashed.

The station is now in its third year of January-to-December operation. Its one 20,000-kw. turbine unit took load first in July, 1927, but the months of that year, the working-in period, do not figure in the economy comparisons in this article. The records of 1928 and 1929 may, however, be considered as adequate statements of performance ability and, by comparisons between them, show how rough spots have been smoothed down to result in economy improvements.

The bare figures of performance do not convey a complete picture of conditions without supplemental information on the plant itself and on its place in the Ohio Edison system. In the first place, Mad River is an easy plant to operate. It is well designed and compact. It includes air preheaters, economizers, water-cooled furnace walls, combination series convection and radiant superheaters, three-stage bleeding for feedwater heating and evaporation, two-motor fan drive on both the forced and induced draft fans, ash sluicing and ash pumping. Feedwater enters the boilers at about 270 deg. F. and the combustion air is preheated to about 250 deg. F. Steam conditions are 400 lb. gage pressure and about 690 deg. F total temperature in average operating conditions.

Mad River is the principal energy source of the Ohio Edison system. During the winter months a 2,000-kw. turbine in another plant is operated non-condensing to furnish steam for district heating in Springfield, and during the four summer months Mad River takes the whole load. The other plant has 24,500 kw. installed capacity, which is the system reserve. It is thus apparent —the condition is shown by the accompanying load curve —that the load factor and capacity factor are not exceptionally good and that Mad River is not at any time a base-load station. A 15,000-kva. transmission tie with Dayton, made this year, and others which probably will



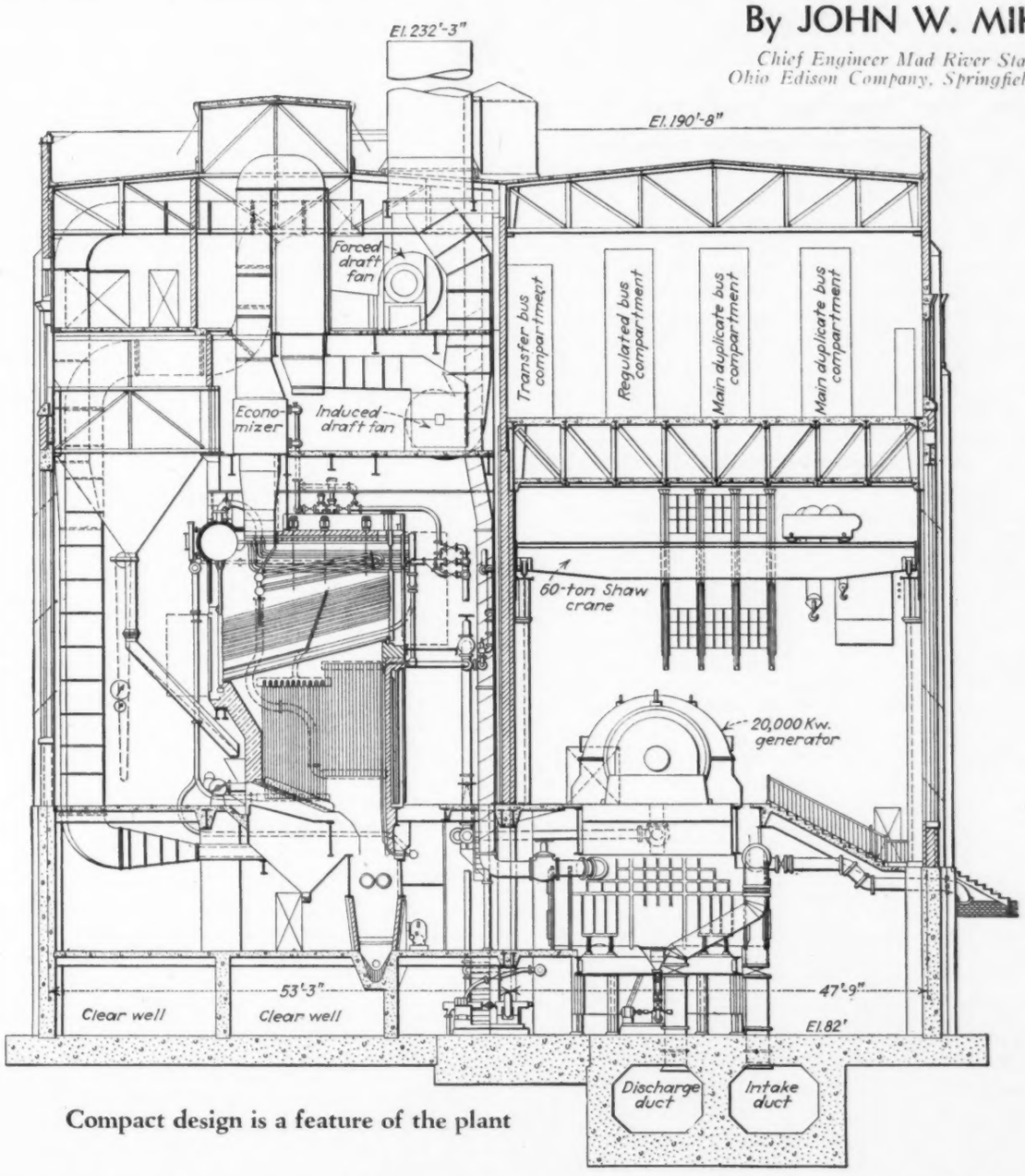
Mad River and its terminal substation

Good housekeeping, outside as well as in, has been a conspicuous factor in the economy of this plant. All of the substation equipment is aluminum painted, which, on account of its light color, requires close attention to cleanliness.

15,923 B.t.u. per Kw.-Hr.

By JOHN W. MIKELS

Chief Engineer Mad River Station, Ohio Edison Company, Springfield, Ohio

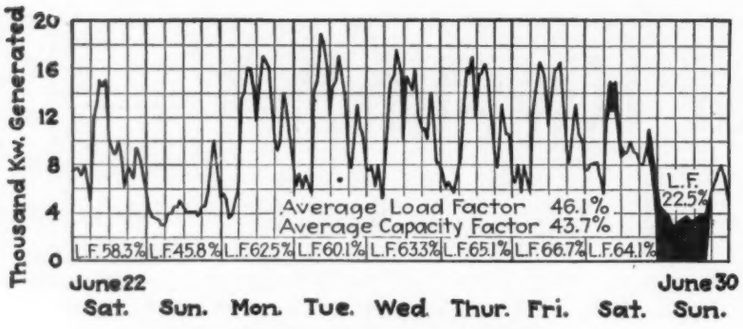


Compact design is a feature of the plant

be made later, will undoubtedly improve the load conditions of the station very materially.

In terms of pounds of coal per kilowatt-hour delivered the fuel consumption dropped 3.76 per cent from 1928 to 1929 and the B.t.u. per kilowatt-hour delivered is 315 less in 1929. As earlier stated, the causes for this improvement are four, better turbine water rate, better boiler operation, lowered station power loss and better grade of coal. The station power losses were reduced by the greater load on the station in 1929 and by a close watch on the station power uses. While the average B.t.u. per pound of coal was only 231 higher in 1929, this was undoubtedly a contributing factor in the bettered economy.

The principal cause for the better coal vs. output ratio in 1929 was the reduced water rate, which was principally due to better condenser operation. The condenser is of the divided water box type, to permit one side to be cleaned while the other is working. Until July, 1929, when the condenser was entirely repacked, this could not



Characteristic summer week load

This week in 1929 included a shutdown of Mad River, shown by black area, when load was carried by the other station on the system.

be done because the vacuum dropped off badly when a side was opened. On account of this difficulty the unit ran much of the time with a dirty condenser, because the circulating water contained considerable quantities of sewage and débris. After repacking, it was possible to clean the condenser, while in operation, every other night in the summer and once a week in winter, and thus keep it clean all the time.

Another reason for the better water rate was the increase in the plant capacity factor from 38.6 to 44.9 per cent, resulting from the increase of output of 16.67 per cent, shown also by the rise in average load of 16.3 per cent giving a more economical operating point to the turbine and a decrease in the number of shutdowns. Shutdowns were reduced by repacking the condenser, replacing a ruptured expansion joint in the eleventh stage, making voltage regulator adjustments, cleaning the intake pressure tunnel, greater faith in the reliability of equipment gained by experience and the greater experience of the operators. A third reason was that the make-up water requirements were about 12 per cent less in 1929 on account of the increased load, better maintenance of small valves and steam traps and reduction of gland leakage on pumps.

More economical loading, more experienced operators, fewer outage hours and less storage coal burned were the causes of the 0.5 per cent improvement in boiler operation in 1929, which contributed to the increased thermal efficiency.

The total generating expense was lowered 0.68 per cent in 1929 from 1928, although the plant output showed a rise of 16.67 per cent. Better operating efficiencies, as previously discussed, contributed to this reduction, as did also decreases in the operating accounts of miscellaneous labor (cleaning up pretty well finished), city water, production supplies, station expense, building maintenance, boiler and stoker maintenance, and others. Another cause was that the price of coal was slightly less in 1929.

Table II—Analysis of Auxiliary Power in per Cent of Total Generated

Power Use	March, 1929, Per Cent	June, 1929, Per Cent	September, 1929, Per Cent	December, 1929, Per Cent	1929, Per Cent	1928, Per Cent	Per Cent Increase or Decrease
Turbine No. 1 auxiliaries	0.213	0.119	0.193	0.202	0.143	0.099	0.044
Circulating pump No. 1.	0.605	0.696	0.003	0.577	0.344	0.508	—0.164
Circulating pump No. 2.	0.526	0.393	0.063	0.696	0.778	0.815	—0.037
Screen house group No. 1	0.004	0.006	0.001	0.003	0.004	0.007	—0.003
Screen house group No. 2	0.199	0.237	0.216	0.176	0.214	0.265	—0.051
Boiler No. 1 auxiliaries..	0.937	0.936	0.993	1.017	0.970	0.958	0.012
Boiler No. 2 auxiliaries..	0.955	0.963	0.941	1.098	0.964	0.981	—0.017
Boiler feed pump No. 1..	0.014	0.486	1.423	0.366	0.605	0.877	—0.272
Boiler feed pump No. 2..	1.465	0.945	0.007	1.257	0.866	0.756	0.110
Coal and ash handling...	0.341	0.298	0.334	0.447	0.342	0.406	—0.064
Miscellaneous power....	0.080	0.168	0.096	0.106	0.142	0.241	—0.099
Lighting (incl. sign).....	0.294	0.243	0.279	0.398	0.289	0.369	—0.080
Total auxiliary power...	5.68	5.69	5.58	6.27	5.71	6.28	—0.570

Table I—Performance Data Compared (1928-1929)

	March, 1929	June, 1929	September, 1929	December, 1929	1929	1928	Increase or Decrease
Kilowatt-hours station generated	6,286,600	6,612,100	6,163,100	6,163,100	78,730,850	67,860,500	10,870,350
Kilowatt-hours station output	5,931,300	6,237,400	6,300,980	5,779,780	74,252,170	63,639,920	10,612,250
Kilowatt peak load	18,700	19,500	19,000	19,000	21,000	19,500	1,600
Period load factor	45.2	47.1	48.75	43.6	42.6	39.65	2.95
Fuel per kilowatt-hour delivered, lb	1.28	1.30	1.33	1.27	1.28	1.33	—0.05
B.t.u. per kilowatt-hour delivered	16,164	16,213	16,429	15,940	15,923	16,238	—315
Water rate, pounds per kilowatt-hour, delivered	11.61	11.79	11.52	11.23	11.45	11.67	—0.22
Boiler efficiency (including economizer and preheater)	86.4	86.9	84.1	84.2	86.3	85.8	0.05
Turbine Room Data							
Average load in kilowatts	8,460	9,190	9,270	8,280	8,990	7,730	1,260
Steam pressure at turbine	394	395	397	398	396	397	—1
Steam temperature at turbine	686	700	687	671	688	688	.....
Vacuum corresponding to temperature	29.12	28.85	28.93	29.47	29.08	29.15	—0.07
Circulating water inlet temperature	51	69	65	42	56	54	2
Circulating water outlet temperature	62	77	76	53	66	63	3
Temperature rise through heaters	106	108	111	100	105	97	8
Boiler Room Data							
Average boiler rating steam	129	142	135	115	131	127	4
Flue gas temperature economizer inlet	601	612	601	587	599	592	7
Flue gas temperature preheater outlet	268	259	253	280	268	262	6
Temperature air outlet from preheater	243	237	233	238	243	256	—13
Coal Analysis							
B.t.u. per lb. of coal received	12,629	12,472	12,353	12,552	12,440	12,209	231
Volatile matter, per cent	35.20	36.35	34.41	34.82	35.32	35.63	—0.31
Ash, per cent	10.14	10.51	10.12	8.87	9.94	10.16	—0.22

Table III—Relative Operating Expenses in Terms of Total

	March, 1929	June, 1929	September, 1929	December, 1929	1929	1928	Increase or Decrease
Superintendence	3.265	3.395	2.910	3.873	3.345	2.853	0.492
Boiler labor	6.300	5.700	5.775	6.040	5.960	5.900	0.060
Turbine labor	6.030	6.255	5.850	5.770	6.070	5.710	0.360
Electrical labor	2.510	2.680	2.230	2.535	2.540	2.520	0.020
Miscellaneous labor	0.972	1.263	1.234	1.153	1.204	1.303	—0.099
Fuel	65.896	69.638	69.043	66.891	68.687	67.622	2.065
Water	0.00	0.00	0.00	0.00	0.138	0.145	—0.007
Lubricants	0.970	0.281	0.188	0.197	0.265	0.153	0.112
Production supplies	0.265	0.475	0.587	0.453	0.389	0.428	—0.039
Station expense	0.967	0.770	1.277	3.395	1.451	1.680	—0.229
Building maintenance	0.937	2.265	2.025	1.803	1.710	1.753	—0.043
Boiler and stoker maintenance	5.660	2.415	3.935	1.851	3.175	3.880	—0.705
Steam accessories	2.460	3.625	4.070	4.340	3.098	2.745	0.353
Turbines and auxiliaries	3.205	0.774	0.590	1.169	1.440	2.017	—0.577
Main generator	0.204	0.047	0.038	0.197	0.123	0.170	—0.047
Control and protective equipment	0.001	0.00	0.00	0.001	0.001	0.023	—0.022
Miscellaneous protective equipment	0.358	0.417	0.248	0.332	0.404	1.098	—0.694
Total steam generating expense	100	100	100	100	100	100	

Table IV—Allocation of Operating Men

	Mad River 1929	Mad River 1928		Mad River 1929	Mad River 1928
Shift engineers	3	3	Coal handling	2	2
Engineers	3	3	Switchboard operator	3	3
Firemen	6	6	Maintenance	6	7
Utility men	1	1	Clerical	2	2
Pump attendant	3	3			

The plant output for 1930 will probably show a major increase over 1929. This should improve the operating efficiencies still more, but it is not expected to raise maintenance costs to any great extent and labor costs should remain about as they have been. While we think that the performance of the station in 1928 was not bad, and we know it was good in 1929, we expect that the record of 1930 will show up even better.

Municipal Plants Decline in Wisconsin

A COMPREHENSIVE analysis of the "forces affecting municipally owned electric plants in Wisconsin" has been made by E. Orth Malott and published by the Institute for Research in Land Economics and Public Utilities (Chicago). Some 130 communities now have or have had municipally owned electric utilities, but within the last ten years 30 of these have sold their plants and systems to the private companies that have extended their transmission systems and brought the economies of large-scale generation and distribution to the doors of the smaller communities. Some of the significant conclusions presented in the report are as follows:

The number of municipal plants in the United States, or in a given state, may be relatively large and yet the output may be very small compared with that of the private systems in the same area without, *per se*, in any way casting a reflection upon municipal ownership. The disparity is caused by the great inequality of size and economic opportunity. Likewise, the average revenue per kilowatt-hour would be expected to be higher for these small municipal plants than for the private plant group which contains large systems with their large-scale production and diversity of load and community.

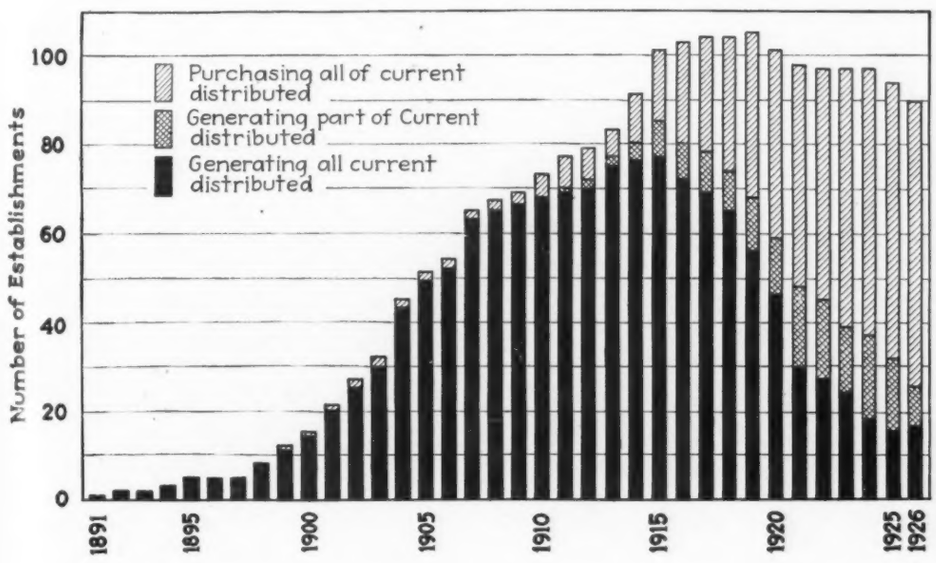
One of the handicaps of small plants is management. In general, the small plant lacks managers with the experience, skill and far-sighted outlook which are possessed by the leaders in large integrated systems. Private plants of small size, as well as public plants, have this difficulty.

Management handicaps were very evident. Overburdened and underpaid public officials were loaded down with duties in relation to the municipal plant. Responsibility was often accepted unwillingly, but no evidence of "graft" or willful mismanagement of the municipal utility was found anywhere in the record. . . . The public managers may have been ignorant and untrained, but the record showed them to be honest, earnest and persevering. . . . Undoubtedly a municipal plant is subject to becoming involved in politics either through the management and employees or through outside interference. . . .

Commission regulation has been very beneficial to the small plant managers. They have been aided in installing satisfactory accounting systems, in developing rate schedules and in similar matters. In addition, municipal plants could turn to the commission for aid in meeting engineering and legal problems. The manager of the municipal plant thus had available facilities somewhat similar to those claimed for private holding company operation. . . .

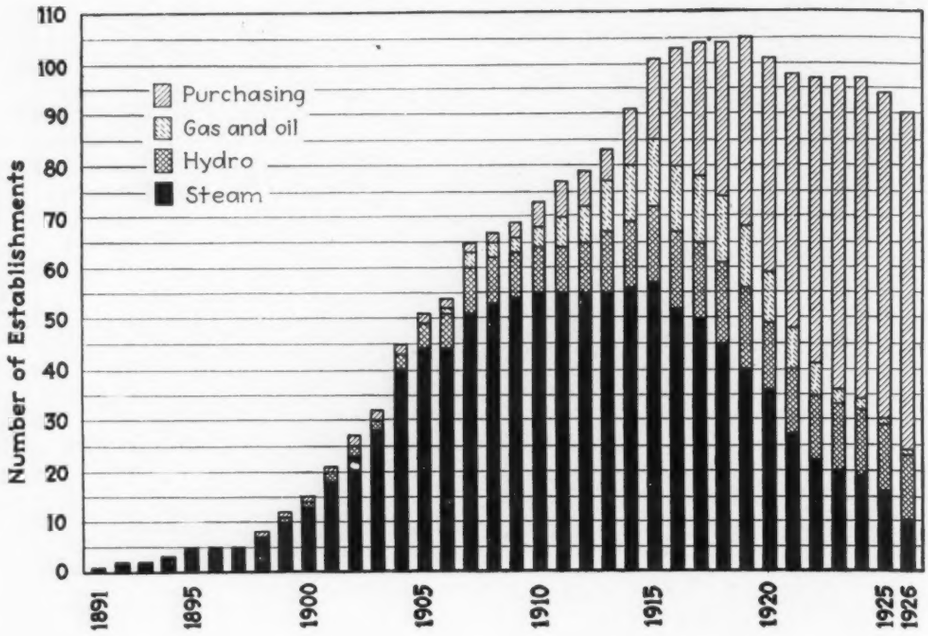
The operating experience of the municipal plants cannot be said to be different from or similar to the operating experience of small private plants. . . .

The general increase in city equity with a corresponding decrease in funded debt indicates an improved financial structure for the municipal plants. In so far as the increase in city equity has been the result of reinvested earnings with



Most Wisconsin municipal plants buy their power

Wisconsin municipal hydro plants holding their own



reasonable rates for service, the taxpayers of the community have profited. In so far as the increase of city equity is the result of taxes assessed against property owners and used by the utility for extensions, the taxpayers have suffered a temporary loss. In so far as the increase of city equity is the result of excessive rates, the taxpayers have gained but the consumers have lost. Regardless of how the increase occurred, the fact remains that the city equity of municipal plants has generally reached a very high level. . . .

The capacity of municipal generating plants has increased because of the growth of individual plants and because small generating plants displayed a tendency to drop out of the generating class. The increase of purchasing plants was facilitated by the spread of private transmission lines. . . . Legal restrictions have prevented the public integration of public plants and private integration has decreased the ranks of municipally owned plants. . . .

The financial handicap, and the technological handicap, which are created by legal restrictions, and the managerial handicap, which in turn is created by the public itself, are the main factors influencing the municipal ownership movement in Wisconsin, whether considered from the point of view of progress, of efficiency, of rates, or of the changing character of ownership.

▼ ▼ ▼

Neutral Ground Current Not Sum of Individual Currents

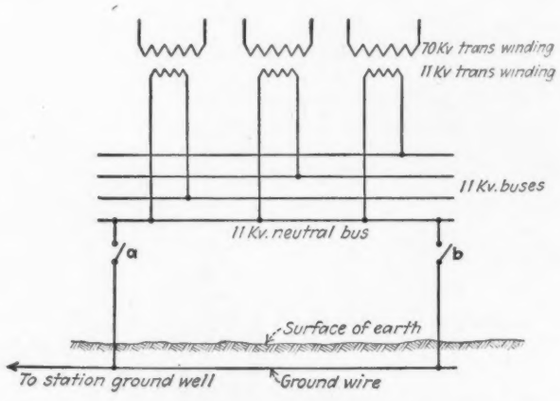
By H. N. KALB

Superintendent Communication
San Joaquin Light & Power Corporation, Fresno, Calif.

NEUTRAL buses are often grounded at both ends in substation yards as shown in the accompanying diagram. The neutral current is sometimes measured by reading separately the currents flowing in the two connections of the neutral bus to ground and the sum of these two readings taken as the real neutral or unbalanced current. This practice is likely where no switches have been placed in the connection between the neutral bus and ground, as is the case in a great many of the substations.

An ammeter was placed in the ground lead from one end of the 11-kv. neutral bus of a bank of 500-kva., 70-kv. to 11-kv. transformers and a reading of 9 amp. obtained. The meter was changed over to the other ground connection and 9 amp. was again read. If these readings were added together it would give 18 amp. as the total neutral current. However, on connecting the ammeter in place of switch *a* and opening switch *b* the meter read 1.25 amp. Placing the ammeter at *b* and opening switch *a* would naturally give the same results and is a true measure of the unbalanced currents in the neutral and likewise the current flowing to the station ground well.

The separate current readings contained load current passing between transformer taps on the 11-kv. neutral bus. The neutral wire in the ground was much larger than the bus and therefore the load current divided, part passing through the neutral bus between transformer taps and part taking the path of the large ground wire. The load current always divides in inverse proportion to the impedance of the paths. All who are concerned with measuring neutral currents should keep these facts in mind, making sure that there is only one connection between the neutral bus and the ground while reading the neutral current, otherwise the reading obtained will not represent the correct value of the current.



To measure ground current correctly, connect ammeter at either *a* or *b* and open the other connection

Dual-Drive Generator Avoids Fourdrinier Shutdown

By F. M. ROBERTS

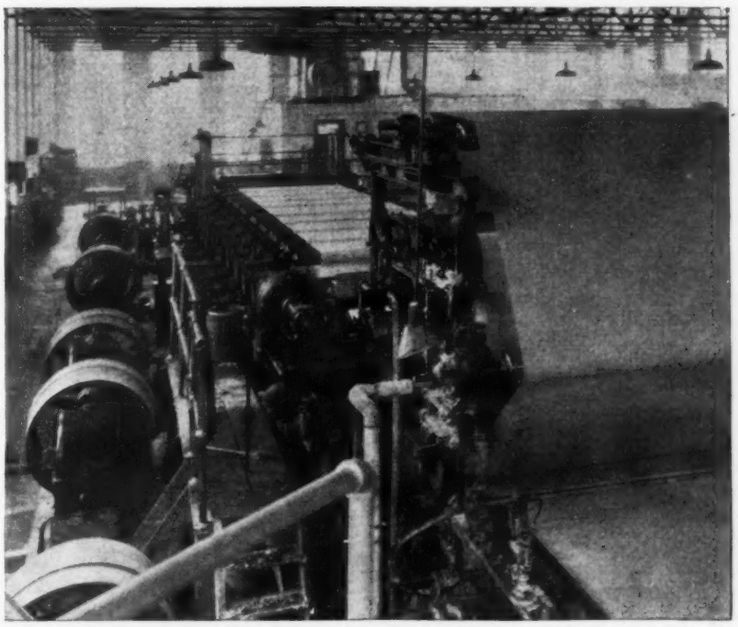
Industrial Engineering Department, General Electric Company

SUCH severe thunderstorms occur in the district around Lee, Mass., in the Berkshire Mountains, that power supply over transmission lines is frequently interrupted. While these interruptions are of short duration, the Smith Paper Company has found that they interfere with the operation of paper machines greatly. A shutdown with stock "on the wire" necessitates a wash-up. Since there may be several interruptions due to lightning during a heavy storm, many hours of valuable operating time may be lost.

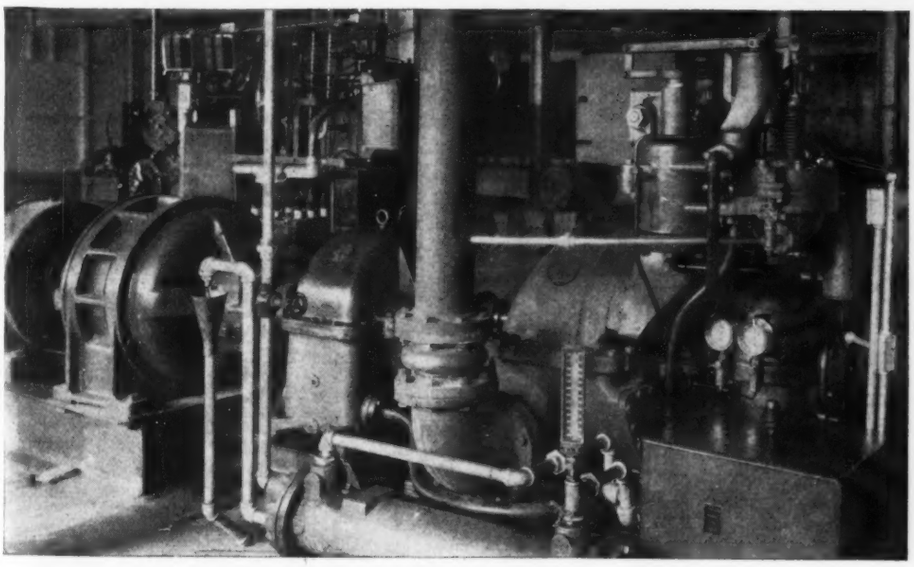
Consequently when the specifications for the new Fourdrinier paper machine, recently installed, were drawn up, one section stated that the driving equipment should provide for uninterrupted operation during periods of interrupted power supply from the transmission system. At the same time maximum flexibility and the best possible speed regulation were to be obtained.

The engineers of the General Electric Company decided that dual (turbine-synchronous motor) drive would best fulfill the exacting requirements of this application. These hopes have been fully justified by the operation of the equipment.

The line shaft of the paper machine is driven by a direct-current motor through a reduction-gear unit, speed

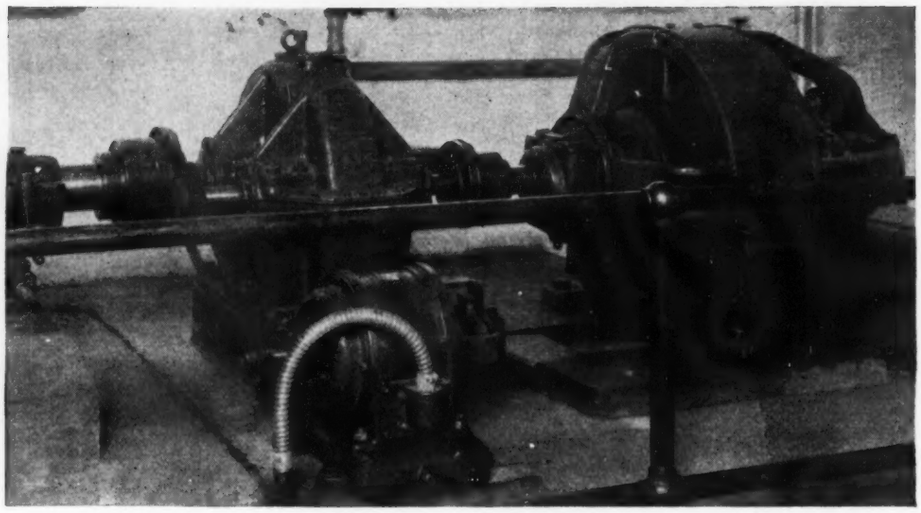


Fourdrinier paper machine for which continuous power supply and flexible speed regulation were essential



Dual-drive generator assures power supply to paper-mill drive

Normally the turbine operates with a back-pressure governor supplying only the drier steam header. Change from back pressure to speed governing of turbine is effected by failure of power supply.



Pilot generator chained to paper-mill drive actuates speed regulator

adjustments being obtained by generator-voltage (Ward-Leonard) control. The direct-current generator supplying the paper-mill motor and its exciter are driven by a turbine and a synchronous motor. Normally, the turbine operates with a back-pressure governor, the speed being held constant by the synchronous motor, which is connected electrically to the power system.

If the transmitted power supply is interrupted in any way undervoltage or reverse power relays trip the circuit breaker, disconnecting the synchronous motor from the a.c. power line. The circuit breaker is interlocked with a magnetic fulcrum on the turbine governor so that opening the circuit breaker simultaneously de-energizes the magnetic fulcrum and the turbine changes from back pressure to speed governing. When this change has been made the turbine carries the entire load, which was previously shared with the synchronous motor.

The increased load on the turbine results in an increase of back pressure which, if it becomes excessive, is relieved by relief valves on the drier steam header. The turbine continues to operate on the speed governor until the operator resynchronizes the synchronous motor with the power system. Between the turbine and motor-generator set is a flexible coupling which can be disconnected so the equipment will operate as a synchronous motor-generator set.

The direct-current motor which operates the paper machine is provided with a commutator type speed regulator. The main coil of this regulator is connected directly across the armature of the pilot generator, which is chain driven from the main motor. Any change of speed of the main motor or of the backline shaft results in a change of the armature voltage of the pilot and in a variation in the excitation of the coil on the speed regulator. The regulator then adjusts the field of the generator for the new condition and maintains constant speed of the backline shaft. The control provides automatic acceleration of the main motor to any point on the speed range as determined by the setting of the generator rheostat mounted beside the paper machine.

▼ ▼ ▼

Developed Water Power Approaches 14,000,000 Hp.

THE total capacity of waterwheels installed in water-power plants of 100 hp. or more in the United States on January 1, 1930, was 13,807,778 hp., according to a report published by the United States Geological Survey. This represents an increase of 236,248 hp., or 1.7 per cent, during 1929, which is unusually small, but will be in part counterbalanced by the much greater amount, about 800,000 hp., to go into operation during 1930.

Public utility plants account for 88 per cent of this total. Of the remainder, more than 60 per cent is in manufacturing and miscellaneous plants in New England and the Middle Atlantic states.

In addition to the statistics by geographical divisions here abstracted the report gives similar data for the individual states. Corresponding figures for 1929 appeared in the ELECTRICAL WORLD of March 23, 1929, on page 588.

Developed Water Power in the United States by Geographical Divisions, Jan. 1, 1930

(Plants of 100 hp. or more)

Division and State	Total		Public Utility and Municipal		Manufacturing and Miscellaneous	
	Number of Plants	Capacity in Horsepower	Number of Plants	Capacity in Horsepower	Number of Plants	Capacity in Horsepower
United States	**3,359**	**13,807,778**	**1,591**	**12,141,846**	**1,768**	**1,665,932**
New England	1,216	1,642,670	261	874,927	955	767,743
Middle Atlantic	588	2,113,313	241	1,844,685	347	268,628
East North Central	391	1,075,434	267	842,453	124	232,981
West North Central	197	551,102	151	439,863	46	111,239
South Atlantic	327	2,657,289	170	2,521,100	157	136,189
East South Central	48	1,168,992	38	1,166,833	10	2,159
West South Central	34	49,237	24	45,912	10	3,325
Mountain	246	1,184,528	192	1,161,455	54	23,073
Pacific	312	3,365,213	247	3,244,618	65	120,595

Factors in Residential Consumption

By P. G. DINGLEDY

Pennsylvania-Ohio Power & Light Company, Youngstown, Ohio

NUMEROUS factors no doubt contribute to the wide variation in the kilowatt-hour consumption of the residential customer among the various cities and towns in the country. Some of these factors are beyond the control of the central station, particularly those intangible factors which have to do with the variations in the inherent character of the inhabitants; others, however, are probably within the control, or at least under the influence, of the central stations' policies, and to this extent the average residential consumption of electricity in a town is a basis for testing the soundness and success of these policies.

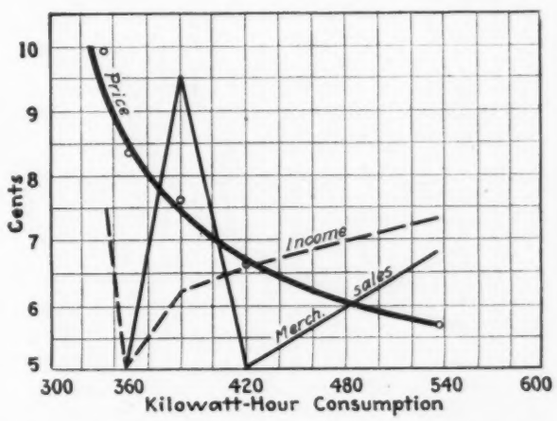
In order to gain some information on the effect of certain tangible factors on the residential consumption of electricity, statistics were obtained from central stations operating in cities of between 100,000 and 300,000 population. (These limits on population were set so as to eliminate as much as possible the indeterminate factors which arise from the varying habits of living in the very small town as contrasted with the great city.) Figures were available for about 50 per cent of the cities in this class and included data on residential consumption, residential revenue, number of customers, domestic rates, number of income tax returns filed, sales of electrical merchandise and other contributory data which might serve as an indication of the general character of the community.

The data thus obtained were used to test the effect of four possible factors in the problem: (1) the average rate per kilowatt-hour, (2) the sales effort of the central station, (3) the type of rate form used and (4) the general prosperity of the community. The first three factors are, to a great extent at least, subject to the control of the central station; the fourth, of course, is much less in its control or wholly outside.

The figures were grouped according to four different classifications; that is, for each of the four factors whose effect was being studied. The method of classification can best be seen in the tables and charts, which present the summarized data of the analysis. In studying the effect of unit price, for example, group limits were set and the average unit price computed for the cities in this group, with concurrent averages of the other factors also figured and superimposed on the charts so as to note possible causes of deviation in the indicated trend. The same procedure was followed in tracing the effect of the other factors.

Table I—Averages for Groups According to Unit Price

Group Limits	Aver. Rate, Cents per Kw.-Hr.	Merch. Sales, Dollars per Customer	Income Tax Ratio	Consumption	Revenue
5–6 cents per kilowatt-hour (four cities)	5.63	6.80	0.317	537	$30.10
6–7 cents per kilowatt-hour (nine cities)	6.58	4.86	0.283	420	27.70
7–8 cents per kilowatt-hour (ten cities)	7.60	9.64	0.262	380	29.90
8–9 cents per kilowatt-hour (eight cities)	8.35	4.91	0.194	347	28.80
Above 9 cents per kilowatt-hour (one city)	9.92	....	0.323	333	33.00



This table and graph show a distinct relation between rate per kilowatt-hour and the consumption. Moreover, the indication is that the demand becomes more elastic as the price decreases, so that a reduction in the price between, say, 5 and 6 cents *would cause a greater increase in the consumption than the same reduction between 8 and 9 cents.* Thus it is not only conceivable but quite probable that lower prices than those found in the cities here studied would result in an increased consumption to the extent that this increase would more than counteract the revenue reduction due to the lower rate, and would thus produce a greater total revenue per customer. Such a conclusion would, however, be questionable in case of a reduction from a relatively high rate to a slightly lower one. The effect of the other factors, particularly the merchandise sales factor, is quite noticeable in this table; the difference in consumption between the first and second group is practically three times the difference between the second and third groups, a discrepancy which is undoubtedly too great to be traced entirely to a greater elasticity in demand. The relatively high merchandise sales per customer in the third group is clearly a contributing cause.

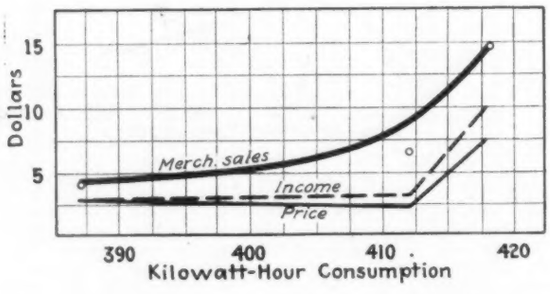
The most accurate criterion available for a comparison of the purchasing power or general prosperity of the various cities was the number of income tax returns filed. While this figure omits, of course, the large number of inhabitants whose income is exempt from taxation, it is nevertheless an indication of the general trend of wages in a city, and has been adopted, in several widely accepted market analyses, as the best standard for judging the purchasing power of a community. In the present study the total number of returns in a community was divided by the number of electric customers, this ratio being termed the "income tax ratio," and representing approximately that percentage of the total of domestic customers which is subject to income taxation.

The tabulated data seem to indicate that each of the factors here considered has an effect on the consumption, as well as on the revenue, although the effect on revenue is, in some cases, not quite as evident. While not shown here in tabular form another factor, the per cent native white population, was also briefly analyzed as a possible cause of variation in kilowatt-hour consumption. The figures were averaged in three groups—above 80 per cent native white, between 70 per cent and 80 per cent, and below 70 per cent. There was relatively little difference in the kilowatt-hour consumption between the three groups, what difference there was being traceable to a slight difference in average rate. Individual cases occurred, which apparently indicated low consumption in towns of high foreign or negro population, but the average figures modified these extremes, so that in general the factor was relatively negligible in the presence of other more powerful ones.

In the light of the data here presented, we may safely conclude that greater development of electrical consumption in the home can be attained (1) by the offering of lower rates for domestic service, (2) by the use of promotional rate forms and (3) by the aggressive selling

Table II—Averages for Groups According to Merchandise Sales

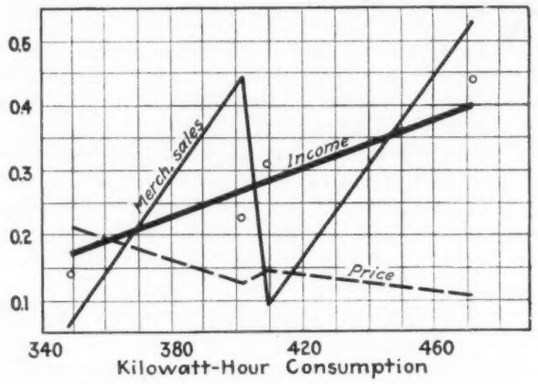
Group Limits	Merch. Sales, Dollars per Customer	Income Tax Ratio	Aver. Rate, Cents per Kw.-Hr.	Consumption	Revenue
$10–15 per customer (three cities)	$14.77	0.299	7.76	418	$32.40
$5–10 per customer (nine cities)	6.86	0.230	7.23	412	29.10
0–$5 per customer (nine cities)	3.86	0.231	7.31	387	27.80



The importance of the merchandise sales factor is further shown in the averages grouped according to this factor. Both consumption and revenue are high with large sales of merchandise, and, due to the higher average rate for the first group, the difference in revenue is particularly apparent. In connection with the factor of merchandise sales, it must be remembered that this item covers only the sale of merchandise by the central station, figures for dealers' sales being unavailable in most cases. The data here presented, however, indicate clearly a correlation between customer consumption and central-station sales effort. Cases in which the central station did no active selling of appliances were omitted from consideration in this section of the analysis.

Table III—Averages for Groups According to Income Tax Ratios

Group Limits	Income Tax Ratio	Merch. Sales Dollars per Customer	Aver. Rate, Cents per Kw.-Hr.	Consumption	Revenue
0.35–0.50 (three cities)	.441	9.27	6.53	472	$30.60
0.25–0.35 (eight cities)	.311	4.82	7.48	408	29.60
0.20–0.25 (ten cities)	.224	8.44	7.26	401	28.90
0.10–0.20 (four cities)	.142	4.55	8.09	349	28.00



While this table apparently indicates that the income exerts a very positive effect on the consumption, an examination of the other data in conjunction with this factor practically contradicts this indication. This is made particularly evident when the effect of the variation in unit price is considered. This is a difference of 64 kw.-hr. between the consumption in the case of the highest income tax ratio and the consumption with the next highest ratio. However, there is also a difference of 0.95 cent in the rate, and the data in Table I indicate that this difference in the average rate would account for a difference of about 60 kw.-hr. regardless of the income tax ratio. Moreover, there is a general lack of consistency throughout the tables in the effect of this ratio, which makes it impossible to draw the conclusion that this factor has at the present time an appreciable effect on residential consumption. Although it is probably true that, in a given town, the wealthier people as a rule are the best customers, yet it is also probably true that in a comparison of different towns the factor of income is overshadowed by the sales activity of the various companies and by their rate policies.

Table IV—Averages for Groups According to Rate Structure

Rate Form	Aver. Rate, Cents per Kw.-Hr.	Merch. Sales, Dollars per Customer	Income Tax Ratio	Consumption	Revenue
With inducement feature (eleven cities)	7.02	6.60	0.249	436	$30.00
Without inducement feature (thirteen cities)	7.71	6.71	0.279	387	29.94

This table shows the value of the promotional form of rate in developing the use of electricity. A great difference in consumption is noted in favor of the group which is served under a rate containing an inducement feature, and although the average rate per kilowatt-hour is lower in the first group, the difference in consumption which may be attributed to this cause is not sufficient to destroy the advantage shown by the promotional form of rate.

of electrical appliances. If, at some future time, the customers in different communities have an equal appreciation of the value of electric service, and spend their income commensurate with this estimate, then the factor of community purchasing power will no doubt become a more potent factor in the problem. The present lack of definite correlation between income and consumption, however, indicates that a wealthy community is not the necessary setting for adoption of the above-mentioned policies, but that practically all communities have an undeveloped market which should respond to the efforts of the central station.

▼ ▼ ▼

Cathode-Ray Oscillograph Without Glass Parts

DURING the last few years investigators have been able to obtain records of lightning disturbances on transmission lines with the aid of the cathode-ray oscillograph. Some of the leading concerns have complete field equipments, installed near transmission lines, to study and to find relief for these phenomena. Disturbances of this nature are exceedingly short-lived, occurring and lasting frequently only a few millionths of a second. The mechanic and photographic end of these "lightning speed" recorders seems to have been fully mastered, but a great deal of difficulty is still experienced with the cathode-ray tube itself. The discharge tube and the deflection tube of this apparatus are made of glass with electrodes fused in (invarconnection). Under continued use, the properties of glass defeat perfect operation of the tube, in that gases are liberated, which affects the vacuum, the cathode gradually evaporates and the arc does not burn as steady as a sharp focus would demand. In addition, great inconveniences and limitations are introduced by having the photographic plate or film within the vacuum.

A novel cathode-ray tube, which seems to overcome all of the above difficulties, was described in the July 3 issue of *Elektrotechnische Zeitschrift*. Glass is entirely eliminated and a window (Lenard window) has been provided, which allows free passage of the recording beam to a photographic plate or film, located outside the vacuum. The new tube is suitable for potentials up to 80 kv. and currents of as much as 2 milliamp. and can be left in operation all day without attention.

The emission window, size 4x6 cm., consists of a Cellon sheet, 0.016 mm. thick, which withstands external pressure due to a reinforcing supporting structure of a fine mesh metal screen and a grillwork of small edgewise steel bars. It is claimed that such a window passes 60 per cent of the electrons with undiminished speed. More than 200 records were made through such a foil without damage of any kind. Investigations on traveling waves made with such oscillographs gave very clear-cut records in spite of the tremendous writing speed of 3,000 miles per second, which allows readings of 10^{-9} seconds.

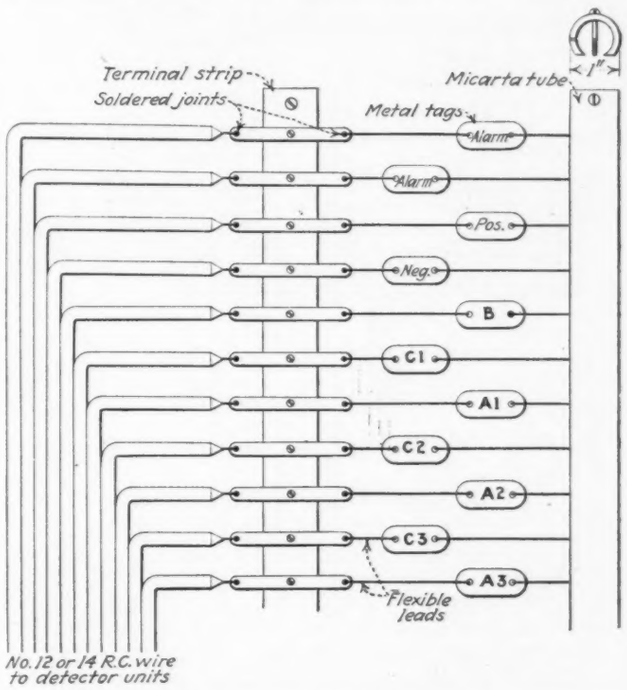
In addition to the above features, the new oscillograph is much smaller and therefore much more portable than the former glass type.

A Solution to the Problem of Bunched Leads

By T. E. MILLER

Tennessee Electric Power Company, Nashville, Tenn.

INSTRUMENTS whose connector resistances are component parts of the measuring arrangement often present an annoying problem to the installer who prides himself on leaving his work in sightly condition. The leads usually come out of the instrument from a single opening and it is difficult to make a good looking job of connecting them to the external circuits. The method used by the Tennessee Electric Power Company, which is illustrated in the accompanying sketch, for connecting up Leeds & Northrup temperature recorders makes a much neater installation than just bunching the leads as is commonly done. This method also makes the leads much easier of identification as the tags are spread out and all face in the same direction.



Bunched leads spread in a tube make a better looking job of instrument wiring

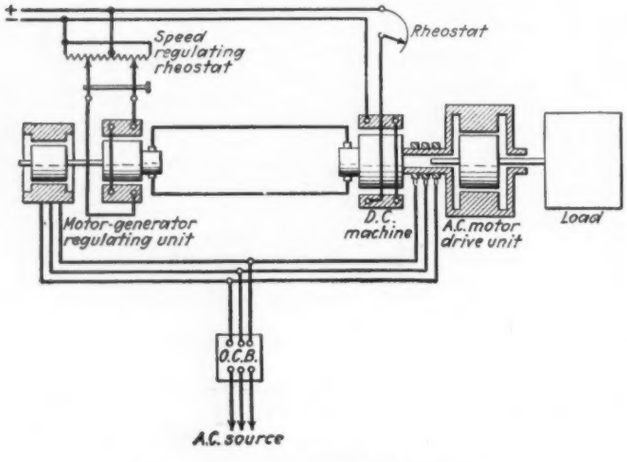
A 1-in. micarta tube cut open flat on one side is placed over the $\frac{1}{2}$-in. hole in the panel from which the bunched leads emerge and from $\frac{1}{16}$-in. holes in the tube spaced according to the distances on the terminal block the single leads are taken out. Making up the leads in this manner requires longer wires at the ends than in the middle of the tube, and since the leads may not be cut off without affecting the calibration of the instrument, it is the practice to make up the assembly loosely at first and then pull the slack of the leads back into the instrument case before tightening the tube down to the panel by means of the screws at the ends.

New Speed Control for A.C. Motors

Being used to operate two pulverizers at State Line and planned for twenty-four auxiliaries at Powerton

By A. M. ROSSMAN
Sargent & Lundy, Inc., Chicago, Ill.

BY CONNECTING a standard type of d.c. machine to an a.c. motor which is electrically standard but which has its frame supported on bearings, and by using a standard type of motor-generator set to control the speed of the d.c. machine, there is obtained a system of speed control of simple design and construction, high efficiency and good speed-regulating characteristics whose speed may be adjusted within the limits of its



Scheme of new speed control

Both a.c. machines are connected to the source of a.c. power. The two d.c. machines are connected in series. The field windings of the d.c. drive machine are connected to a source of constant direct-current potential. The field windings of the d.c. regulating machine are connected to the same source through a rheostat which is capable of transforming this constant potential into potential varying by small increments from maximum positive through zero to maximum negative. With constant excitation on the d.c. drive machine the direct current in the main circuit is directly proportional to the load torque and in the same direction. This current does not reverse when the d.c. drive machine reverses its direction of rotation, but it does reverse when the torque reverses.

design by simple d.c. field control rheostats. This system of speed control has a wide field of application in many classes of service.

Two drive units of this type, each rated 300 hp. (250-hp. induction motor and 50 hp. d.c. motor) at 720 r.p.m., capable of being operated at any speed between the limits of 620 and 480 r.p.m., have been driving coal pulverizers in State Line power station, near Chicago, since April, 1929. Each drive unit has its own regulating unit. The load is in the class that calls for constant torque at all speeds.

Twenty-four drive units are now being built for the power station of the Super Power Company of Illinois, located at Powerton, near Peoria. Twelve of these units, each rated 419 hp. (330-hp. induction motor and 89-hp. d.c. motor) and capable of operating through a speed range of 100 per cent to 40 per cent (1,088 to 444 r.p.m.), will drive induced draft fans. The other twelve units, each rated 166 hp. (141-hp. induction motor and 25-hp. d.c. motor) and capable of operating through a speed range of 100 per cent to 46 per cent (1,004 to 468 r.p.m.), will drive forced draft fans. In this application each regulating unit controls two drive units. The d.c. drive machines and the regulating units are standard apparatus, taken directly from the manufacturers' lists. These 24 motor units, aggregating 7,020 hp., require but 1,140 kw. in motor-generator capacity for their speed control.

The new sysem employs two two-machine units, a drive unit and a regulating unit. A constant speed a.c. motor of either the induction or the synchronous type and an adjustable speed d.c. motor comprise the drive unit. The a.c. motor differs mechanically from standard types in that both the rotor and the stator are free to rotate about their common axis. The rotor is connected to the load; the frame is connected to the d.c. motor so that it may be rotated by, or it, in turn, may rotate the d.c. motor. Current is delivered to the a.c. motor windings through collector rings. The d.c. motor is of standard type, shunt wound, with the field separately excited from an auxiliary source.

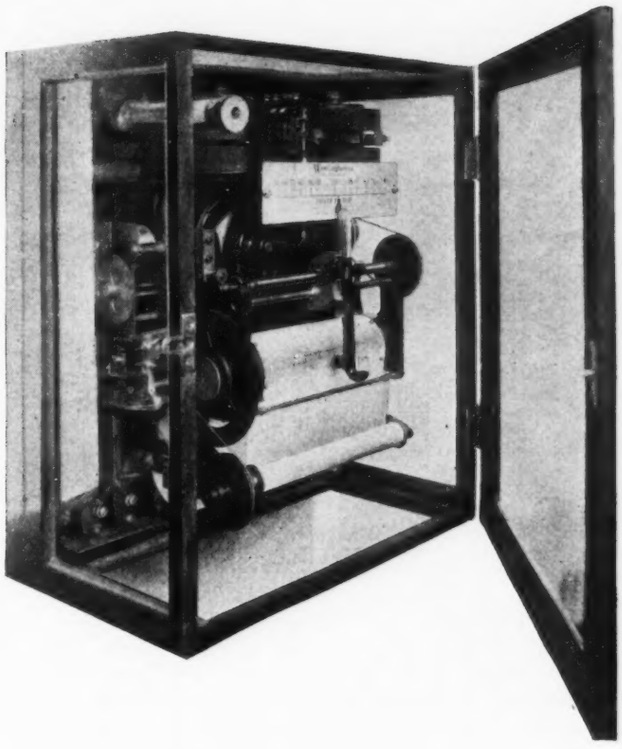
The regulating unit is a standard type motor-generator set. The voltage of its d.c. machine is adjustable between the limits of zero and maximum, in either positive or negative direction. The d.c. regulating machine acts sometimes as a generator, delivering power to the d.c. drive machine; sometimes as a motor, receiving power from the d.c. drive machine, and driving its erstwhile motor as a generator.

When its frame is at rest the a.c. drive motor acts as a standard type motor running at rated speed. This constant speed between rotor and frame is held at all times. If a higher load speed is desired, voltage is built up by increasing the excitation of the d.c. regulating machine, which then delivers energy to the d.c. drive machine. The latter then acts as a motor to drive the a.c. motor frame in the same direction as the rotor. With constant field excitation the d.c. drive machine tends to rotate at a speed in direct proportion to the d.c. voltage impressed on its terminals. The speed of the frame and hence the increase in speed of the load are thus built up in the same proportion.

If a lower load speed is desired, the voltage of the d.c. regulating machine is built up in the opposite direction. This causes the a.c. motor frame to drive its d.c. machine in a direction opposite to that of the rotor and causes it to deliver energy to the d.c. regulating machine, which, in turn, acts as a motor to drive the a.c. motor of the regulating unit as a generator. The last machine then delivers energy to the a.c. supply system. The decrease in the speed of the load is at the same rate as the change in d.c. voltage.

The mechanical connection between the two machines of the drive unit may be any one of several different forms. The d.c. machine may be direct connected to the rotating frame, as shown in the drawing; it may be connected through multiple V-belts, or it may be belted, geared or chain driven.

Meter graphs
polyphase power factor



Polyphase Power Factor Recorded by New Meter

By L. J. LUNAS

Westinghouse Electric & Manufacturing Company

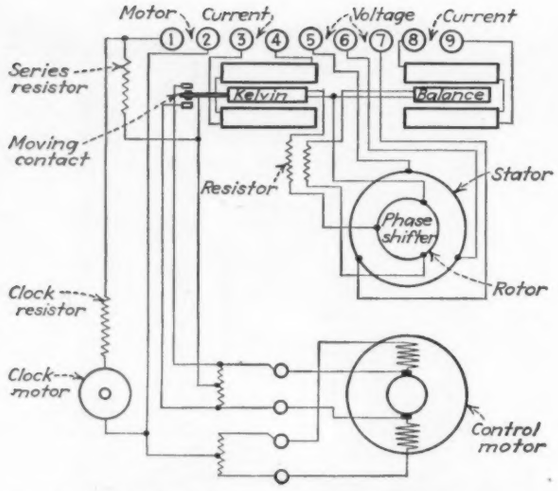
THE simple definition of power factor as the ratio of watts to volt-amperes has long been recognized as being adequate only for single-phase circuits. In the case of polyphase circuits power phase unbalance alters conditions so that the usual power-factor meter gives readings which are entirely meaningless. Unbalance being more common on smaller systems, the determination of true power factor is an important problem to the majority of power systems. This article describes a recording power-factor meter which has recently been developed to indicate and record polyphase power factor according to the A.I.E.E. Standards, which are recognized today as being the official definition of true power factor.

The A.I.E.E. has only comparatively recently adopted the following definition of power factor: "Power factor in a polyphase circuit is the ratio of the total watts to the vector sum of the volt-amperes in the several phases." This "vector" power factor may be quite different from the power factor of any individual phase, as may be seen from the power vector diagram in the accompanying illustration.

Meter based on Kelvin balance principle

The instrument operates on the well-known relay principle, in which a Kelvin balance operates a set of contacts in the circuit of the control motor which drives the worm-driven pen. The Kelvin balance wattmeter element is mechanically balanced and will close either of the two contacts in the control motor circuit, depending upon whether the element torque is positive or negative. If the torque is positive the element will close one of the contacts completing the control motor circuit, causing the motor to drive the pen up scale. Conversely, if the torque is negative, the other contact will be closed and the pen driven down scale. A phase shifter is mechanically connected to the recording mechanism by means of a worm wheel meshing with a worm gear at the end of the pen-driving worm. The gear ratio is such that when the pen is driven the length of the scale the phase shifter produces a corresponding shift of 120 electrical degrees between the current and voltage. The primary winding of the phase shifter is connected to line voltage and the secondary winding is connected to the moving coils or potential circuit of the Kelvin balance wattmeter element.

The principle of operation will be made clear from the following discussion: If a Kelvin balance element is arranged as a wattmeter, by connecting the stationary coils in series with the line and the moving coils across the line the torque will, of course, be proportional to the power in the circuit. If the current in the potential coils is shifted by means of a phase shifter so that it lags line voltage by 90 deg. the torque of the Kelvin balance element will then be proportional to the reactive volt-



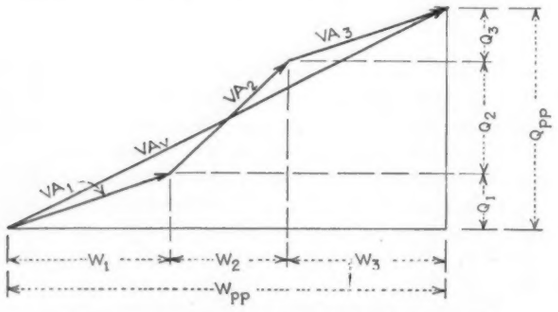
Motor shifts phase of voltage to produce zero torque at Kelvin balance

amperes in the circuit. With this condition the torque of the element would of necessity be zero when the power factor of the line was unity. For any other value of line power factor the element would have a torque proportional to the variation of the power factor from unity. If the quadrature current in the voltage coils is obtained by means of a phase shifter, the angle through which the phase shifter must be rotated to give rise to the condition of zero torque in the element is the same as the vectorial mean angle of lag or lead.

Any power factor produces torque balance

Therefore, for any power factor of the line, the circuits of the Kelvin balance element are brought to a condition resulting in zero torque. Any change in line power factor will produce a torque on the meter element, causing the control motor and phase shifter to readjust the system mechanically and electrically to the new power factor.

From the accompanying illustration it will be seen that the stationary coils of the Kelvin balance element are connected in series to give the effect of two current coils. The co-ordination of the system of Kelvin balance, control motor and phase shifter keeping the torque of the element zero of necessity causes the pen to assume positions on the scale corresponding to the vectorial mean angle of lag or lead. The cosine of this angle is the vectorial power factor as recognized and defined by the A.I.E.E., so the scale is marked accordingly.



Vector sum vs. numerical sum of polyphase volt-amperes

The total active power of a three-phase unbalanced circuit is represented by Wpp, which is equal to the sum of the power in the individual phases ($W_1 + W_2 + W_3$). Similarly, the total reactive power Qpp is equal to the sum of the reactive power in the individual phases ($Q_1 + Q_2 + Q_3$). However, it is obvious that the sum of the volt-amperes in the three individual phases ($VA_1 + VA_2 + VA_3$) is not the same as the resultant sum VA_v. If individual single phase power factor meters were used they would measure: $\frac{W_1}{VA_1}$, $\frac{W_2}{VA_2}$ and $\frac{W_3}{VA_3}$. But these values, even if averaged, would be meaningless on such a polyphase circuit due to the unbalance. It would, of course, be possible to determine the true power factor of an unbalanced circuit by taking the ratio of the readings of a polyphase wattmeter and a polyphase reactive volt-ampere meter. But these readings would not be direct, making it necessary to compute the true power factor.

▼ ▼ ▼

Arc-Welded Boilers Not Far Off

THE day of the all-arc-welded boiler is not far away according to G. E. Koch of Westinghouse Electric & Manufacturing Company, in an address to the Master Boilermakers' Association convention. Already the maximum size of boilers and ultimate efficiency of steam power plants are fixed by the limitations of the riveted joint, Mr. Koch maintained, and with the demand for higher plant efficiencies being reflected in larger boilers and higher steam pressures, plate thicknesses are increasing to a point where riveting is out of the question. Boiler drums are already being made at great expense from seamless hollow cylinders, a product of the steel piercing mills. The boiler manufacturers are turning eager eyes toward the arc-welding processes used in the construction of similar vessels, such as oil cracking stills, which have long been made for higher pressures and temperatures than are common in boilers. Vessels with 6-in. walls have been made by arc welding and not a single service failure has developed.

Arc-Welding Speeds Compared

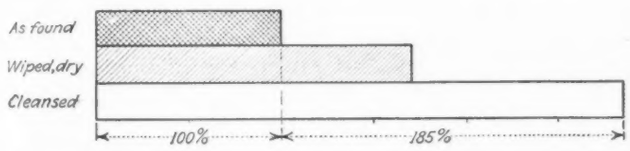
Manual Welding				Automatic Welding			
Plate Thickness, In.	Wire Size, In.	Amp.	Feet per Hour	Plate Thickness, In.	Wire Size, In.	Amp.	Feet per Hour
$\frac{1}{4}$	$\frac{5}{32}$	250	3	$\frac{1}{4}$	$\frac{3}{16}$	350–275	15
$\frac{3}{16}$	$\frac{1}{4}$	225	4	$\frac{3}{16}$	$\frac{3}{16}$	310–280	23
$\frac{1}{8}$	$\frac{3}{16}$	175	6.5	$\frac{1}{8}$	$\frac{3}{16}$	360	45
$\frac{3}{16}$	$\frac{5}{32}$	150	9	$\frac{3}{16}$	$\frac{3}{16}$	340	60
$\frac{1}{8}$	$\frac{1}{8}$	125	15	No. 12	$\frac{5}{32}$	200	100
				No. 14	$\frac{5}{32}$	185	120
				No. 16	$\frac{5}{32}$	185	165

The greatest contribution toward reliability and consistency in arc welding is the development of the automatic welding head, declared Mr. Koch. It replaces the trained eye and hand of the welder to maintain thermal conditions at the arc, and it does the job much more quickly. It can be adjusted for a given arc length, welding current, and welding speed, as dictated by experience on a given plate thickness, and will produce uniform results even on irregular surfaces. When the boiler codes make provision for arc welding they will in all probability specify automatic arc welding.

A Steel Mill Viewpoint on Adequate Lighting

AN ADEQUATE lighting system is one fulfilling the following requirements, according to R. F. Sanner,* assistant electrical engineer Carnegie Steel Company, Duquesne, Pa.:

1. Provides sufficient illumination for every person in the lighted area.
2. Prevents eye strain by the proper selection and installation of lighting equipment
3. Avoids sharp shadows and glare by carefully placing the lights and equipping lamps with reflecting and diffusing devices.
4. Avoids the use of individual lights, except for special cases, by providing a general distribution of illumination throughout the area.
5. Provides for turning lights off or on, either singly or in small groups.
6. Provides for proper maintenance of the equipment at regular intervals.
7. Has a feeder and distribution system so designed as to have available at the outlets a voltage which corresponds to one of the standard voltages for which lamps are manufactured.



Cleansing the unit added 185 per cent to the light

Cleaning should be regular and thorough. The dirt on lighting units is only partially taken off by wiping; its complete removal calls for the use of a cleaning compound. This operation adds little to the total time required and is well repaid by the gain in illumination. For example, from one unit, previously tested as found, the downward light was increased 71 per cent by wiping with a clean, dry cloth; but upon cleaning the lamp and reflector with a compound the increase became 185 per cent.

Methods for facilitating adequate maintenance depend on local conditions. With high mounting a runway on the crane may provide access to the lamps. If the lighting units are equipped with disconnecting hangers fresh ones can quickly be substituted to replace those removed for cleaning; a saving of time results.

Examples of present usage in steel mill lighting include a rolling mill installation, area about 40,000 sq.ft., lighted by 42 750-watt lamps with 20-in. RLM reflectors 23 ft. above the floor, giving an intensity of 8 foot-candles; high mounting of 1,000-watt prismatic reflector units, 46 ft. above the floor, with illumination intensities as great as 12 foot-candles on the charging side of an open-hearth building; a triple row, also of 1,000-watt prismatic units, furnishing 22 foot-candles on the working plane for chipping billets.

The discussion brought out the desirability of high-intensity general lighting in preference to local lighting, though examples of the latter by means of portable two-lamp standards were given, to provide the high intensity needed under present rigid requirements for inspecting and chipping billets. Some mills use intensities exceeding 40-foot candles for this class of work.

Fixing the responsibility for turning the lights on or off appears still to be an unsolved problem. Now that the load in a single building is on the order of 50 kw., the economy of using photo-electric cell control was suggested.

For assuring continuity of lighting service one mill has provided a 6,600-volt circuit from the power house for lighting service only. This circuit supplies energy to all the mill lighting transformers, and thus the disconnecting of any mill or substation power circuit for maintenance does not interrupt the lighting service in any part of the plant. Further assurance of 100 per cent lighting service has been provided for by making it possible to feed these transformers from either the power house or a mill switching station at 6,600 volts. Thus any section of the lighting circuit may be disconnected without discontinuing service.

From address before Association of Iron and Steel Electrical Engineers, at Buffalo.

▼ ▼ ▼

New York's Rural Service Up 73 per Cent in Four Years

THE remarkable progress made by New York State in rural electrification during the past four years is shown by the following tabulation taken from a recent report of the Empire State Gas and Electric Association:

	Status of Development January 1, 1926	Status of Development January 1, 1930	Per Cent Increase in Four Years
Miles of lines	9,500	15,990	68
Farms in state	188,000	.....	..
Farms using service	30,800	53,060	72
Additional farms (within 1 mile of line)	36,600	47,000	28
Rural customers (including farms)	162,400	280,900	73

The principles upon which New York State is developing its rural electric service are, briefly, as follows:

1. No contribution toward the cost of the line supplying service should be made by the farmer, unless he desires to do so in order to secure a lower minimum monthly charge.

2. The user of the service should pay the full cost of furnishing such service, so that other users will not be burdened.

3. There should be no special rate applicable exclusively to rural electric service, but the farmer should receive the same rates as apply in the nearest urban center, with proper modification in the minimum monthly charge.

4. Farm rates should include reasonable minimum monthly charges, which should be about $24 per mile of line per month.

5. The minimum monthly charge per mile of line ordinarily should be divided equally between the customers on the extension.

6. When additional customers are secured or when further extension of the line is made the minimum monthly charge shall be recalculated.

Electrical Switzerland

Lack of fuel resources forces use of electricity. Load factor business accented. Economic and technical features of Swiss electrical development

Barberine station of the Swiss Federal Railroads

SWITZERLAND is the United States of Europe. It has a Constitution based upon that of America and its traditions and standards bear a striking similarity to those prevailing in the States. There is a uniformity about Switzerland that is very attractive and the absence of many wealthy individuals can be contrasted with the absence of many poverty-stricken inhabitants, to lead to the conclusion that most Swiss are well-to-do. Splendid homes abound and the people take great pride in their educational system and the business enterprises that have capitalized the Swiss mechanical genius.

Switzerland is forced to import all raw materials, manufacture them and sell them in the markets of the world without the advantages of seaports or special tariff agreements. To do business under these conditions requires skilled workmanship, sales ability and the utilization of every possible advantage in manufacture.

In comparison with her neighbors Switzerland is an electrical country. The homes use electricity for light, water heating and cooking, the railroads are electrified, the streets, highways and stores are well illuminated by electric lamps and the industries use electric power almost entirely. A traveler through Switzerland at night sees electric lights twinkling on every side and each mountain village and city is a mass of glowing light.

Why does Switzerland rely so greatly upon electricity? The answer is that in one sense she was forced to and in another sense that the business was promoted and sold. Switzerland is a land of water power, with no fuel resources, and during the war a great impetus to electrical development came because all fuel importations practically stopped. To live and to do business Switzerland had to use electricity for light, heat and power, and, because equipment could not be installed quickly or power resources developed rapidly, the people learned to use electricity on a load factor basis, whereby all possible hours' use could be had of the installed capacity. Under these stimuli and with intelligent leadership the Swiss light and power companies produced 3,736,000,000 kw.-hr. of electricity in 1929 from installed capacity capable of producing about 5,000,000,000 kw.-hr. Of the electricity produced 990,000,000 was exported to Italy, France and Germany and the Swiss used 2,746,000,000 for their own purposes. In addition, the four state-owned railroad power plants produced 400,000,000 kw.-hr. to operate the national transportation system.

The itemized division of electric kilowatt-hour sales may be stated as follows for 1928 and 1929:

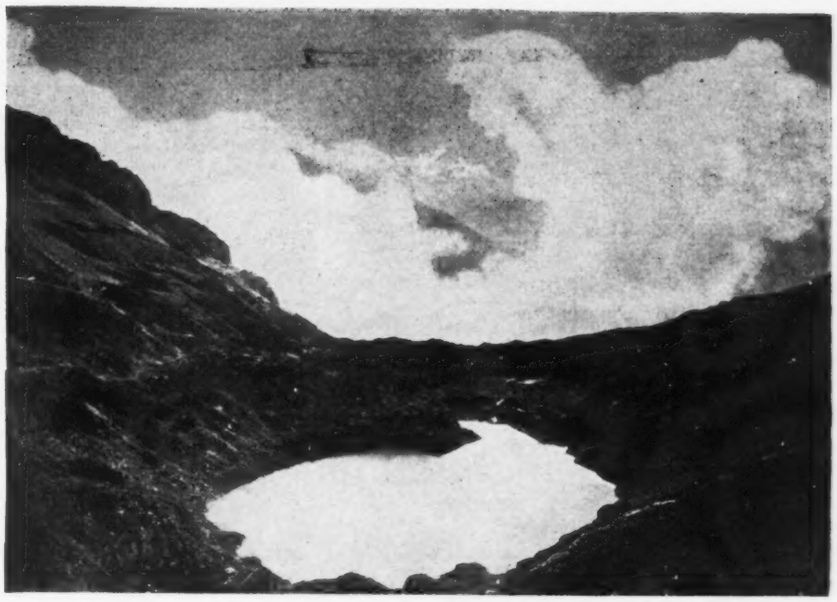
	1928	1929
General industrial and residential	1,955,000,000	2,142,000,000
Chemical and electrical furnaces, pumped storage	586,000,000	535,000,000
Exported	1,107,000,000	1,059,000,000
Total	3,648,000,000	3,736,000,000

Swiss Energy Used by Months

Million Kilowatt-Hours

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
1927	258	241	266	268	281	275	286	293	298	302	288	294	3,350
1928	279	274	302	282	311	302	317	324	312	315	312	318	3,648
1929	323	274	276	297	317	315	345	346	329	317	300	297	3,736

By L. W. W. MORROW
Editor ELECTRICAL WORLD



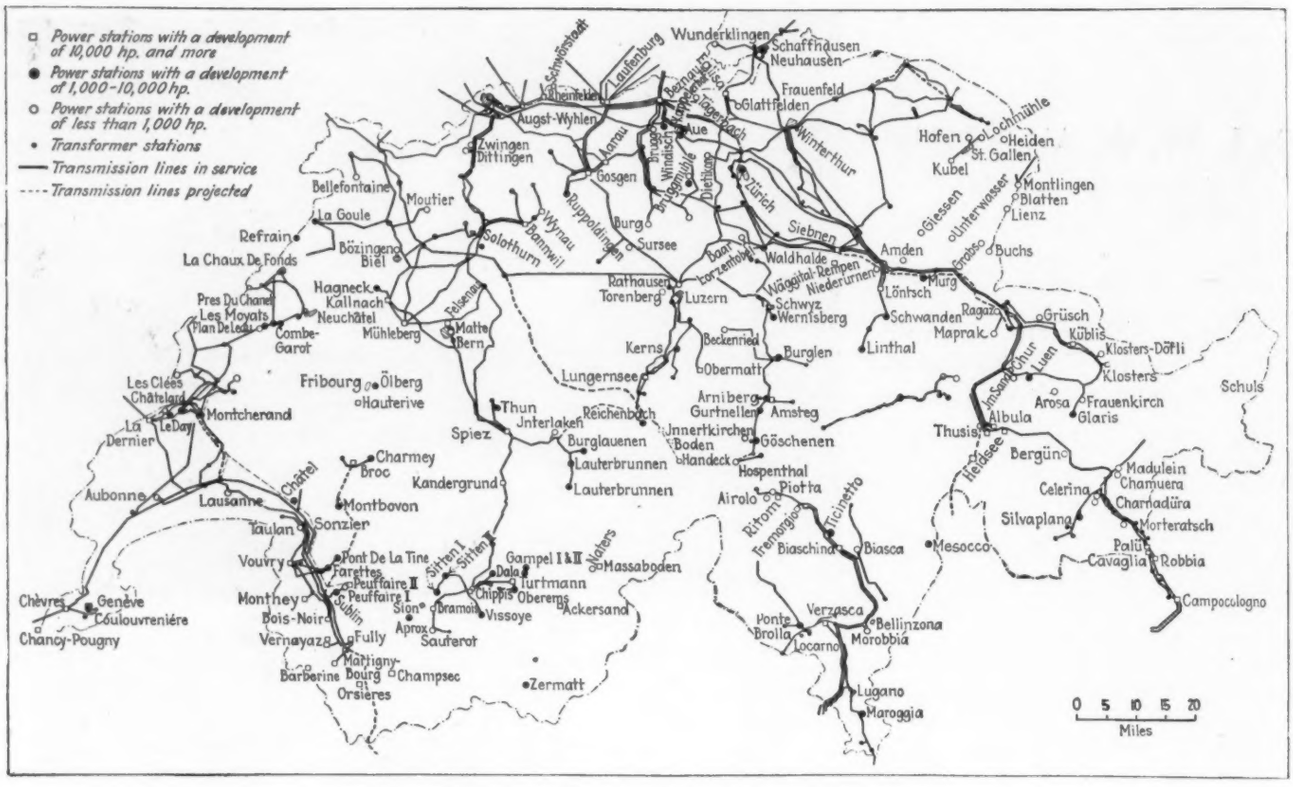
Mountain reservoir for Fully station in Valois

Thus, on a percentage basis about 52 per cent of the electricity is used for general light and power, 13 per cent for the electrochemical and furnace industry, 25.3 per cent for railways and 9.7 per cent is exported. The summer production exceeds that of winter, the export figures reflecting this condition with 581,000,000 kw.-hr. in summer and 409,000,000 kw.-hr. in winter.

Water power in Switzerland is subject to many variables and intelligent development of water-power resources has been had by considering many factors. In the high Alpine regions the volume of water discharged from melting snow and glaciers is large in the middle of the summer and comparatively small in winter. In the lower mountain regions the volume of water is large when the snow melts in April and June and also depends upon the rainfall, which is heaviest in the spring and fall, and there is comparatively little summer flow. In the still lower tablelands the volume of water depends on the discharge from the higher regions and is greatest in the spring and fall. Thus in winter in all regions the volume of water available is small and the variation in volume increases as the altitude increases.

To regulate somewhat the volume of water some of the

Site of the Grimsel storage of 22,000,000 gal. for three power stations to produce 550,000,000 kw.-hr. per year from the Aar waters



General layout of Swiss electrical developments

larger lakes, such as Greifen, Jura, Lucerne, Zurich and Geneva, have been made into storage ponds by artificial means. Some of the small mountain lakes have also been used for this purpose. In addition several artificial storage ponds, such as Waeggital, Barberine and Montsalveris, have been created and the surplus water in spring and summer is pumped into these lakes for winter use.

As a consequence of water variation and climatic conditions some ponds are used on a yearly basis and some on a monthly and a daily basis. Power stations are used for winter service only in some cases and as pumping plants in summer. Other stations in the high mountains are of little use in winter. Thus Swiss water power has been developed largely as combined stream flow and storage plants and winter and summer plants. High-head stream-flow plants are tied to other high-head storage plants, dams on low-head plants are used as daily storage reservoirs, plants on different watersheds are tied together, pumping of water to reservoirs is common practice during seasons when water supplies are good, surplus power is used for export and for special electrochemical and metallurgical purposes. A large network transmission spreads the energy where needed and acts as a transfer bus for pumping and generation.

Probably the most interesting because unusual phase of the development, however, is the high load-factor business that has been sold by intelligent effort under inducement rate systems. For example, in one small village of 2,000 people the day load was 300 kw. and the night load 400 kw. This was brought about by the use of storage hot water heating in the homes. A time switch and a low rate caused people to heat hot water from 9 p.m. to 6 a.m. and gave a splendid load factor. This principle has been applied to homes and to industries, and as a consequence the load factor of Switzerland is very high.

In 1929 the peak load for the light and power companies was 620,000 kw. and in 1927 it was 600,000 kw.,

Swiss Extend Appliances 15 per Cent in Year

	Connected at End of 1927		Connected During 1928		Connected at End of 1928	
	Number	Kw.	Number	Kw.	Number	Kw.
Ranges, cookers, boiling plates	108,000	208,500	15,600	55,100	123,000	263,600
Kettles, teapots, percolators	163,000	69,080	13,000	5,150	176,000	74,230
Toasters	33,000	12,830	2,300	1,090	35,300	13,920
Irons	556,000	229,600	47,000	20,500	603,000	250,100
Fires and heaters	198,500	246,200	31,000	33,600	229,500	279,800
Hot water storage tanks	52,000	83,000	17,400	20,800	69,400	103,800
Bake ovens, pastry ovens	350	9,700	30	300	380	10,000
Boilers	520	3,080	90	570	620	3,650
Warming and drying cupboards	6,610	5,500	70	170	6,680	5,670
Fodder boilers for cattle	1,210	2,610	480	1,030	1,690	3,640
Various other appliances	43,810	62,900	3,550	3,490	47,470	66,390
Totals	1,163,000	933,000	130,520	141,800	1,293,640	1,074,800

Electrical Balance Sheet for Zurich, 1928

Population, 240,000
Number of customers, 83,000

Total investment in property	$18,800,000
Investment already amortized	6,600,000
Residue investment	1,200,000
Total revenue	4,200,000
Total expenses	3,500,000
Net revenue	751,000
Domestic use, kw.-hr.	30,000,000
Industrial use, kw.-hr.	78,000,000
Street railway use, kw.-hr.	15,440,000
Total use, kw.-hr.	152,576,000
Per capita use, kw.-hr.	639

Amsteg station of the Swiss Federal Railroads

yet energy production in the same period increased from 3,350,000,000 kw.-hr. to 3,736,000,000 kw.-hr.

The stream-flow stations had a minimum peak of 250,000 kw. in January and February of 1929 and a maximum peak of 550,000 kw. in the summer. The storage plants cared for the excess peak load and the additional energy requirements of the year. Thus interconnection, stream-flow plants, pumped storage plants and rates are all tied into the economic equation to produce maximum returns from the investment. Switzerland is trying to let no water get away and yet is keeping investments in equipment to a minimum.

The total capital investment in Swiss light and power property is about $300,000,000, of which about $110,000,000 represents municipal investments and $190,000,000 that of the state and private interests. Swiss electrical properties are of several types. Municipalities and cantons own stations and distribution systems very largely, the state owns the railway plants and lines and the state and the cantons as well as private companies own transmission systems that link together the water-power plants.

Local distribution and sale is in the hands of the municipalities, which fix rates sufficient to get revenue to amortize capital and pay bond interest and in addition give a revenue that amounts to about $3 to $4 per capita, which is used for general corporate purposes. The national government must give its consent for export of power and for the building of transmission lines, but the cantons control the water rights.

Swiss rates per kilowatt-hour for light in homes range from 6 to 10 cents, for ranges 1.4 to 1.6 cents and for off-peak water heating 0.6 to 0.5 cents. Possibly a good picture of a typical municipal property is given in the accompanying data for the city of Zurich for 1928.

The growth of load in Switzerland is very satisfactory and as a general rule municipalities sell appliances as well as electricity. No very aggressive merchandising methods are used, but the appliances appear to be of very good quality and are well displayed for sale. The further growth of Swiss electrical systems is tied up to load growth and the increase in export power. With Germany, France and Italy as neighbors and building extensive transmission systems, it should be economical to use Swiss water power in each of these countries in an increasing degree.

▼ ▼ ▼

Distribution Changeover Without Interruptions

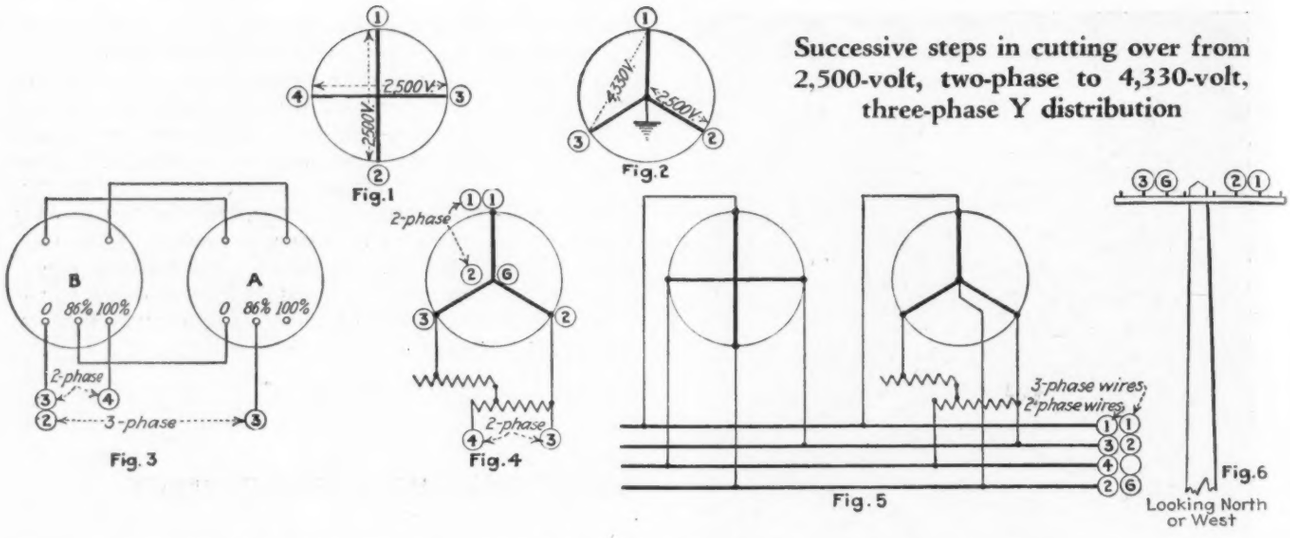
By FRANK S. JONES
City Light Department, Seattle, Wash.

IN CUTTING over from a 2,500-volt, two-phase to a 4,330-volt, three-phase distribution system, engineers for the city of Seattle devised a method which eliminated feeder interruptions and avoided stringing in extra wires. The first section cut over was a heavy commercial district having a load on the two-phase feeder of approximately 500 kva. per phase, a large percentage of which was two-phase and three-phase motor services.

The two-phase, 2,500-volt primary system is ungrounded, with no physical tie between phases. The 4,330-volt, three-phase primary is a four-wire Y system grounded at the station only. Figs. 1 and 2 show the phase relation between the two systems. Since the phase relation and voltage between wires 1 and 2 of the two-phase system and wires 1 and ground of the three-phase system are the same, these wires can be multiplied. To get the proper phase relation and voltage between wires 3 and 4 of the two-phase primary and wires 2 and 3 of the three-phase primary two transformers with 86 per cent taps in the 2,500-volt winding were connected to wires 2 and 3 of the three-phase primary. (Figs. 3 and 4.) The 100 per cent winding of the 500-kva. transformer was then of proper phase and voltage to be multiplied with wires 3 and 4 of the two-phase primary.

Since the load was approximately 500 kva. per phase, a 250-kva. transformer was used at "A," but inasmuch as the portion of the winding between the 86 per cent and the 100 per cent taps of transformer "B" had to carry the full load of the phase, it was necessary to use a 500-kva. transformer at "B." The secondaries of those transformers were multiplied. The next step was to multiple the 2,500-volt, two-phase primary with the 4,330-volt, three-phase primary (Fig. 5). The two-phase primary was then killed, leaving the three-phase feeder to carry the two-phase load.

The secondary lighting distribution system used is a 125/250-volt, three-wire system with a grounded neutral grid. This neutral is mostly No. 4 wire. The secondary neutral was replaced with heavier wire for a few blocks around the feed-in point of the feeder and tied to the



Successive steps in cutting over from 2,500-volt, two-phase to 4,330-volt, three-phase Y distribution

Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6

ground wire of the three-phase primary. This gave five primary wires on the poles, with the three-phase ground wire and the secondary neutral in multiple.

The next operation was to cut over all transformer taps from the two-phase primary wire 2 (three-phase ground wire) to the secondary neutral. The ground wire was then transfererd from the "Y" point of the three-phase primary to wire 3. With all three wires of the three-phase feeder on the pole and the secondary neutral still serving as a temporary ground wire, the next procedure was to cut the load over and balance it on the three-phase primary. Most of the power services were three-phase and were transformed from the two-phase primary with a Scott-connected bank of transformers.

On each of these services the 86 per cent, or teaser, transformer was cut over to full winding and connected open delta with the other transformer. A phase rotation indicator was used to check rotation. Each operation of this kind took about 30 minutes. On the smaller two-phase services (5 kva. or less), the two transformers were connected open delta and a three-phase to two-phase auto-transformer installed. On two-phase services up to 50 kva. capacity one of the transformers of the bank was replaced with a 4,330-volt transformer which was connected for two-phase with the remaining 2,500-volt transformer. On larger two-phase services both transformers were replaced with 4,330-volt transformers, one of which was a teaser. To make these changes it was usually necessary to kill the service for a short time. In cases where it was inconvenient to do this during working hours the work was done before 8 a.m., during the noon hour or on Sunday.

When the foregoing operations were completed all the load had been cut from two-phase wire 4. Fig. 6 shows wire positions adopted as standard for the entire system. In order to get the wires into their proper positions it was necessary to kill and multiple the wire which had no load with one of the other wires and change transformer taps from one to the other. This process was repeated until all wires were in their proper positions. The taps were then transferred from the secondary neutral to the ground wire and the cutover was complete.

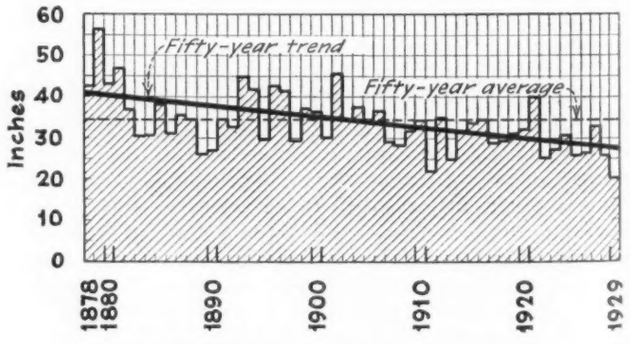
Approximately 7,000 kva. of load has been cut over by this method without dropping or kicking out a feeder.

Decreasing Rainfall Affects Hydro Output

THIS chart of annual rainfall for a 52-year period is taken from the report of the Puget Sound Power & Light Company for 1929. A mathematical analysis of the yearly figures on the assumption of a straight-line trend shows that the annual average at the beginning of the period was 40.1 in.; at the end it was 27.5 in. The latter is 69 per cent of the earlier rainfall.

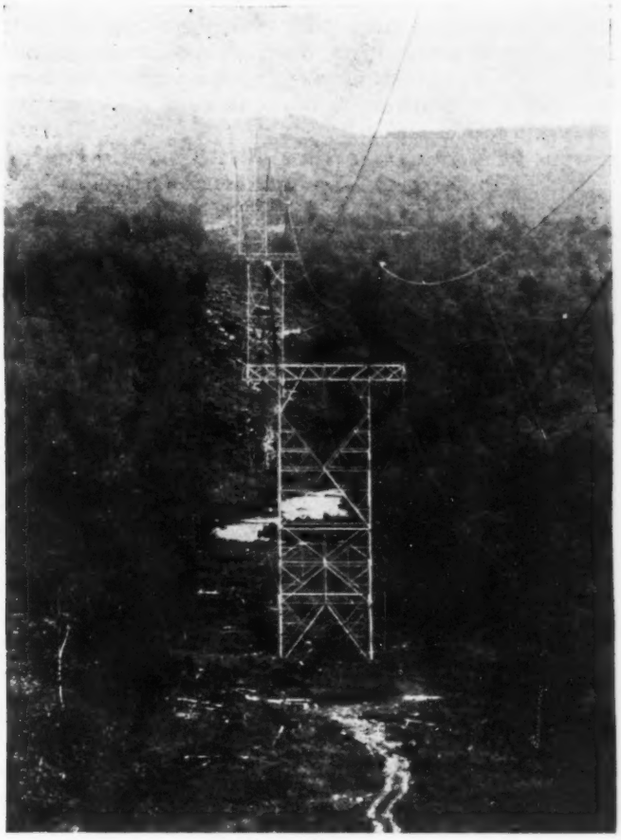
The extremely low rainfall in 1929 accounts for the curtailment of water-power production and for the increased load on the steam plants of systems having a mixed supply. Compared with the long-time average of 34.05 in., this 20.03-in. precipitation was about 14 in. short of normal, but it was only 7.5 in. under the 1929 trend point.

The chart does not predict the future; it does not



Pacific Northwest suffers from 50-year decrease in rainfall

justify the assumption of a completely arid Northwest in 110 years; it applies only to the past and only to a specific locality. But it does indicate that the long-time trend for rainfall, which may quite as well be a rising as a falling one, adds still another variable to the problem of system planning.



Wallenpaupack 220-kv. line with lightning-diverting cables over conductors

Diverting Direct Strokes

By A. E. SILVER

Electrical Engineer
Electric Bond & Share Company

THE Wallenpaupack-Siegfried 220-kv. transmission line of the Pennsylvania Power & Light Company has been the seat of extensive lightning research since it was first put in service in the spring of 1926. There are two reasons: It was the first 220-kv. line to be built in the East, and operating experience promptly showed that its location crossed several areas subjected to frequent and heavy lightning discharges. The equipment employed and results of this lightning research have been, from time to time, published and discussed through the medium of the A.I.E.E. and a description of the design of the line itself appeared in the ELECTRICAL WORLD, July 24, 1926.

In addition to the more basic lightning research referred to above, the Pennsylvania Power & Light Company has been experimenting, in certain sections of the line, for the purpose of finding measures to overcome the effects of lightning on service. Two definite sections of this line, where it crosses over separate hill ranges in the northern half, are outstanding in the registered per mile number of severe lightning strokes and they have been chosen for this experimentation.

One of these sections, adjacent to the Wallenpaupack generating station and extending along the line over High Knob, a total of approximately 20 miles, was shielded by conventional overhead ground cables in 1927. (Overhead ground cables were omitted from the line in the original construction.) This installation proved only partially effective and recently further experimentation, in the way of rather extensive work over the entire 20 miles, largely to reduce tower footing resistance, has been carried out. The completion of this work is too recent to permit judging the results conclusively. The experimentation on the other of these two sections, a length of 3¾ miles, beginning approximately 22 miles south from Wallenpaupack, is believed to be novel, and therefore of sufficient interest to justify fuller description.

The cumulative results of all lightning research, including the 1929 season, encourage belief in the possibility that in highly insulated lines, especially such as 220 kv., induced strokes have already been brought under control and that only direct strokes to some portion of the lines are of sufficient severity to interrupt service by spilling over the insulators. Accepting this possibility as a working premise, it was assumed that if direct strokes could be intercepted and diverted to ground without making contact with the line conductors service interruptions would be avoided.

Method of Supporting Cables

A variety of methods for applying direct-stroke-diverting masts and diverting cables, some supported on and some supported separately from the line supports, were studied and the one outlined in the accompanying illustration was finally chosen for this experimental installation. Its general arrangement and appearance are shown in the accompanying illustrations, taken after completion of field construction. As will be seen, the diverting cables are supported approximately 50 ft. above the plane of the conductors at the tower by vertical masts footed in the tower crossarm. At the top the masts are bridled together and guyed four ways to ground anchors for mechanical support. Electrically,

these guys and anchors are of primary importance, as they constitute the direct path from the overhead diverting cables to earth. All the electrical connections and anchor contacts are designed to give a path of low surge impedance from diverting cables to earth.

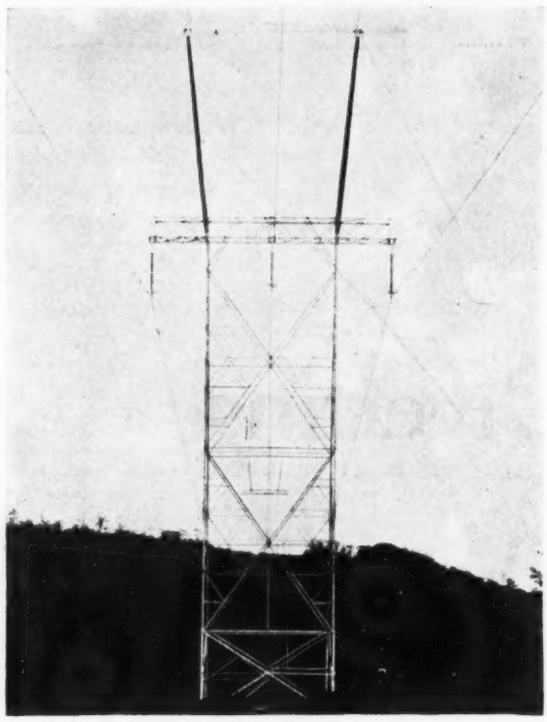
To eliminate a parallel flow of lightning discharge current to earth through the towers, which very likely would set up a potential difference across the insulators sufficient to cause flashover, the supporting masts were made of insulating material, wood being used.

As an expected further control of the potential difference across the insulators, the guys were bonded to the tower, these bonding cables being laid underground in order to improve the grounding of the guy anchors. Owing to the lack of even approximate knowledge of the lightning discharge currents and voltages to be dealt with, the necessary separations and clearances for the diverting cables could be arrived at only by calculations from assumptions. As a means of gaining information of the discharge currents flowing over the several possible paths during a lightning stroke, the entire installation has been liberally equipped with direct-stroke recorders and other measuring devices in use by the lightning research project.

In somewhat greater detail, the design of this particular application is as follows:

In undertaking the design, it was known that excessively heavy sleet prevails in the territory traversed. Also, the towers and footings had not been designed originally with any intentional provision for the additional load which would be imposed by this installation. Consequently, there was made for each tower a very careful check under the added loads to insure against reducing the adopted margin of strength of the supporting structures. Some reinforcing of a few towers was found necessary.

The structure consists of two 40-ft. creosoted yellow pine poles mounted in vertical position on the bottom of the crossarm at the center of the longitudinal face of the tower. The connection at the tower is made by stepping the pole in a socket which terminates in a hinged joint. The bridle, the side guys and the lightning-stroke-diverting cables are attached to special socket caps inverted over the top end of the poles.

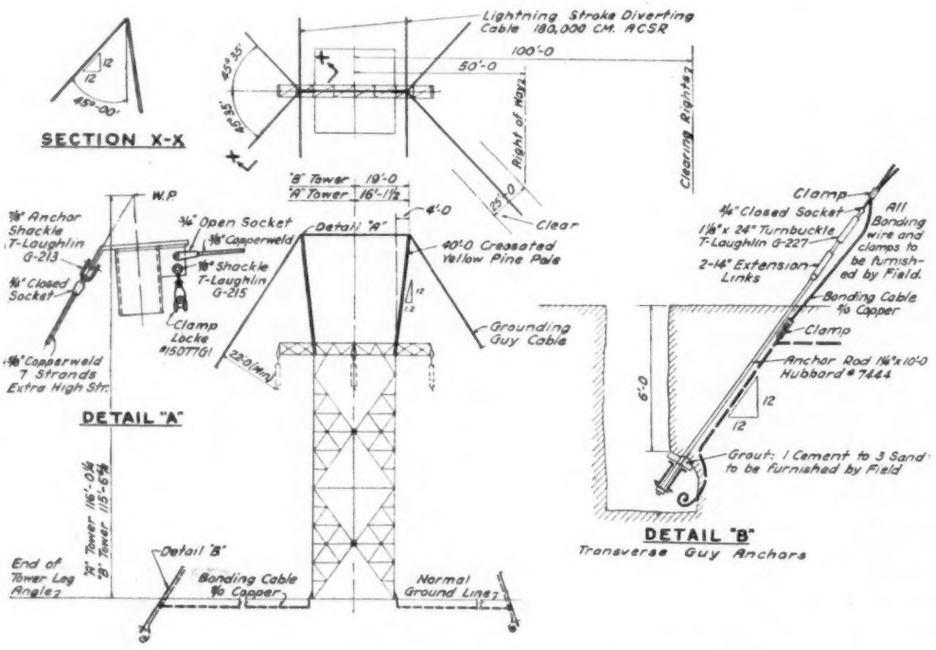


Installation of lightning-stroke-diverting cables on 220-kv. Wallenpaupack line

It is evident that with this assembly all transverse and longitudinal loads are carried by the guys and only vertical load is imposed on the tower. Due to the severe vertical loads the poles were selected with much care to obtain sound timber and sticks with minimum sweep.

The lightning-stroke-diverting cables consist of two 180,000 - circ.mil A.C.S.R. cables comprising 18x0.101 aluminum and 12x0.1214 steel strands sagged to a tension of 16,000 lb. under 1-in. radial ice, 8 lb. wind at 0 deg. F. The cable is hung in suspension clamps designed to slip between 3,000 lb. and 5,000 lb. unbalanced tension. At the clamp it is reinforced by armor rod vibration dampers as recommended by the manufacturer.

The transverse and bridle guys are of $\frac{5}{8}$-in. extra-high tensile copperweld steel having an ultimate strength of 29,000 lb. Each guy was cut to length as calculated



Detail of diverting cables on wood insulators on a 220-kv. tower

from a field survey and fitted with sockets before being delivered on the job. The guys are equipped with 1⅛x24-in. turnbuckles and adjusting links to facilitate the aligning of the poles.

Guys are anchored by means of a 1¼-in. x 10-ft. anchor rod to a fabricated steel "deadman" with a designed resistance to uplift of approximately 30,000 lb. Each guy is bonded to the adjacent tower leg by a No. 2/0 bare copper cable buried 18 in. below the surface of the ground.

The maintained normal air separation between the transverse guys and adjacent power conductors is 22 ft.

The two diverting cables are dead-ended at each end of the experimental installation by means of a standard A.C.S.R. compression type dead-end clamp to a special pole cap similar to those used on the suspension structures. The longitudinal loads created by these dead-ends are carried by longitudinal guys of $\frac{13}{16}$-in. extra-high tensile copperweld steel having an ultimate strength of 50,000 lb. These guys are socketed and equipped with 2x24-in. turnbuckles and adjusting links to provide for any necessary adjustments in length. The guys are anchored by means of a 2⅛-in. x 15-ft. anchor rod to a steel and concrete anchor having a designed resistance to uplift of 60,000 lb.

Construction was rushed to completion during June and it is hoped by the end of the lightning season to have sufficient experience to indicate whether, within practical limits of physical dimensions and clearances, this type of 220-kv. line will be "lightning-proof."

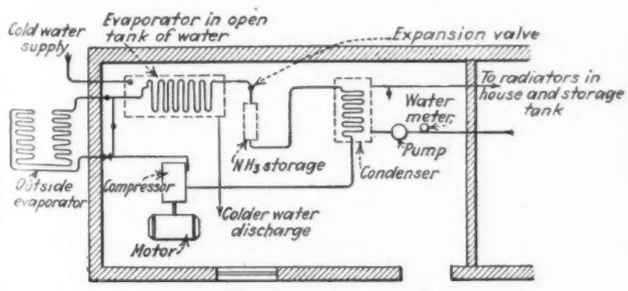
It may be added that a few days after the completion of this installation it encountered a direct stroke of lightning with discharge current of the order of 100,000 amp. without a resulting insulator spillover.

▼ ▼ ▼

Reverses Refrigeration Process for House Heating

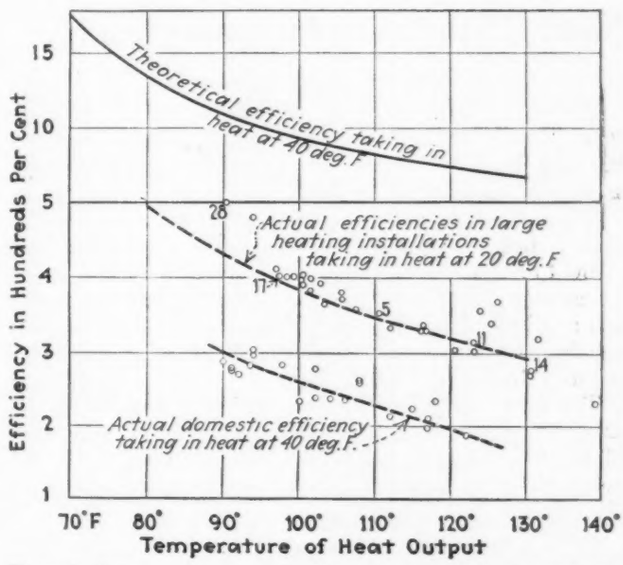
JUST because 1 kw.-hr. of electrical energy produces at best only 3,414 B.t.u. is no reason why electricity cannot be used to heat buildings economically, declares T. G. N. Haldane, an associate member of the British Institution of Electrical Engineers. He points out that by reversing the function of a refrigerating plant it can be made a heat pump and an electric motor will only be required to transfer heat from low-temperature surroundings to the interior of a building. Consequently the heat equivalent of the power delivered to the motor would be only a small portion of the heat delivered to the radiators. This is more evident in the ordinary domestic electric refrigerator, where the heat taken out of a relatively cold food-preservation compartment is delivered to the condensing coils at an uncomfortably high temperature.

Expressed more scientifically, the efficiency of this scheme is based on the Carnot cycle of heat conversion, namely, efficiency (in 100 per cent) equals $T_1/(T_1 - T_2)$ where T_1 is the high temperature and T_2 the low temperature. Thus if heat is delivered at 100 deg. F. (560 deg. abs.) and taken from the atmosphere at 40 deg. F. (500 deg. abs.) the efficiency is 560/(560 — 500) equals 933 per cent. That is to say, for every B.t.u. of electric energy delivered to the heat pump 9.33 B.t.u. will be delivered at 100 deg. F. to the radiators. This economy becomes greater as the temperature range is decreased.



Reversed refrigerating plant heats the Haldane home

A heating system working on this principle has been installed by Mr. Haldane in his home in Scotland. The elements of it are shown in an accompanying sketch. In the cold weather heat is absorbed directly from the atmosphere by the outside evaporator and from 40-deg.



Comparison of actual "heating efficiency"* in Haldane home with theoretical and actual results in large experimental installations

From a summary of tests made on six different heat pumps by L. A. Jenks, New York; Eastman Kodak Company; G. A. Horne of Merchants Refrigerating Company, New York; Denton & Fry's factory at Bristol. The size of these experimental installations ranges from 45 to 130 kw.

Test	Temperature (Deg. F.) Evaporating	Condensing	Range	Heating Efficiency* Actual	Ideal
28	+14	84.5	70.5	500	771
17	+ 6.6	95.4	88.8	404	626
5	+ 5.3	95.8	90.5	351	615
11	— 1.1	101.9	103.0	313	545
14	— 8.6	101.9	110.5	275	509

* Heating efficiency is ratio of heat equivalent of energy input to motor to heat output.

circulating water from the street main in the tank evaporator. In the warm weather it is unnecessary to run water through the evaporator tank because sufficient heat can be absorbed by the coils exposed to the air.

During the winter the system supplies both domestic hot water and heat. In the summer it is run only for domestic hot water and to supply ice. The additional 20 or 30 deg. above the radiator temperature of 100 deg. F. is obtained by immersion heaters. The maximum load on the compressor motor is 5 kw. Results of a number of tests of the efficiency over a prolonged period are shown. Higher efficiencies might be expected with large installations.

Generally speaking, Mr. Haldane's experience is that the plant is extremely satisfactory and requires very little attention. The adjustment of the expansion valve was found to be the only operation involving some care, but this has been obviated by an automatic expansion valve.

The dollar economy of this installation has not been presented by Mr. Haldane, but he has calculated that the combined fixed and operating costs of such a system saves 30 per cent of the cost of heating public baths by fuel.

▼ ▼ ▼

READERS' FORUM

Some Thoughts on Increasing Loads

To the Editor of the ELECTRICAL WORLD:

The editorial in the July 19 issue of the ELECTRICAL WORLD on "Those Sales Executives the Industry Is Waiting For" refreshes the memory of some thoughts as to how to increase the load.

The writer is not connected with the electrical industry, but has exposed some of the ideas mentioned below to several sales executives without getting a spark. These men were connected with large holding companies and admitted that the sales of household appliances were actually at a loss but a necessary evil in order to increase the load factor.

The past few years have seen a rapid growth as well as radical changes in methods of heating various types of buildings. Unquestionably the next few years are going to see even more radical changes in this necessary element for human comfort.

Since the industrial field is possibly the biggest outlet for electrical energy, it might be well to review briefly the changes in heating practice for this type of building:

Up until recent years practically all heating for this type of building was done with either pipe coils or radiation. Recently unit heaters have been used practically exclusively to replace the old type, not only in new buildings but also in older structures to modernize heating plants. Briefly, a unit heater consists of a copper or aluminum heater element behind which a propeller fan is placed, circulating air over the heating surface and distributing this heated air uniformly through the space to be heated. The horsepower required for these units runs from about 1/30 to 15.

One case which comes to mind involves a two-story garage building in a city of 25,000 population. Sixteen unit heaters were installed, each requiring $\frac{1}{6}$ hp. All of these units were in service approximately six hours a day and one-half in service for the balance of the day. It might be well to point out that during the summer months the motors were also operated to circulate air in order to secure a cooling effect.

Assuming a 60 per cent motor efficiency would mean a current consumption of approximately 200 watts per hour per unit.

$$\begin{aligned} 16 \times 200 \times 6 &= 19{,}200 \text{ watt-hours} \\ 8 \times 200 \times 18 &= 28{,}800 \text{ watt-hours} \\ &\overline{48{,}000} \text{ watt-hours} \end{aligned}$$

or 48 kw.-hr. for winter service, which would possibly be reduced to 24 kw.-hr. for summer use. A conservative average throughout the year would possibly be between 30 and 36 kw.-hr. You can figure the revenue yourself.

Why not have your cashier include a small circular on unit heating when mailing invoices to your industrial accounts?

These unit heaters can also be used for stores, creameries, public buildings, etc., and they will show your customer a definite fuel saving.

Then, coming to the home—humidifiers and fans for furnaces are items which can be recommended and will give a respectable increase in the billing price month for month.

It is going to be a question of only a very short time until cooling and air conditioning will be demanded for the modern home. The electric refrigerator manufacturer will have to supply larger units to take care of the normal demand for domestic use and also provide sufficient capacity of, say, from 6 to 10 gal. of water per minute for air conditioning. The motor load will possibly run from 1 to 2 hp. for the average eight-room home over and above that needed for refrigeration.

Do you know that butchers are losing from 10 to 15 per cent of the weight of meats because the present methods of cooling also take the moisture from the meat? I believe that a unit heater circulating cold air and with a suitable humidity control will overcome their troubles, and this will mean more current used.

The few thoughts given previously could be augmented indefinitely without a whole lot of trouble. The sales executive could well afford to have on his staff a competent heating engineer who could prepare data to assist his power salesmen in presenting examples of this kind to your customers.

R. H. ANDEREGG.

Chicago, Ill.

New Indiana Transmission Map

THE Public Service Commission of Indiana announces that, through its engineering department, it has just recently completed a revised edition of the transmission lines in the State of Indiana.

The map sets out the voltage of the various lines, location and size of power houses, substation capacity, whether municipally or privately owned, and other miscellaneous information. It is blue line on cloth, 42x66 in. in size.

Men of the Industry

L. R. Coffin Assumes New Duties

LESLIE R. COFFIN, manager of the eastern district of the Puget Sound Power & Light Company and manager of the Washington Electric Company at Wenatchee, Wash., has been appointed manager of the central district of the Puget Sound Power & Light Company, Seattle, to succeed Richard M. Boykin, recently resigned to join the executive staff of the Electric Bond & Share Company, New York City. Mr. Coffin was manager of the northern district with headquarters at Bellingham, Wash., prior to the war. He left that position to join the Hog Island shipyard organization at Philadelphia. After the war he went to California with Stone & Webster and then started his own business. Several years ago he returned to the service of the Puget Sound Power & Light Company as manager of its eastern district, later becoming manager of the Columbia River development. Mr. Coffin will be succeeded in Wenatchee by LOUIS M. SHREVE, now sales manager at Wenatchee.

▼

C. E. DOVE, formerly manager of the southern division of the Interstate Power Company, has been appointed assistant general manager of the company. Formerly Mr. Dove was associated with the electric light and power industry in Indiana for a number of years.

•

J. Z. KELLY has recently assumed the duties of promoting rural line extensions in the territory supplied by the Delaware Power & Light Company, Wilmington, Del. Mr. Kelly received his technical training at the Carnegie Institute of Technology and his early experience with the Westinghouse Electric & Manufacturing Company. He became associated with the Delaware company in 1925, when it was operating under the name of the Wilmington & Philadelphia Traction Company.

•

GEORGE W. W. CORNMAN, treasurer and manager of the service department of the Brown Instrument Company, Philadelphia, Pa., has retired from business, effective August 8. Mr. Cornman has been associated with the instrument business for 35 years, having been formerly secretary and treasurer of the Keystone Electrical Instrument Company. When that organization was absorbed by the Brown Instrument Company he became treasurer and a director of the present organization and was the active head of the service department.

•

PROF. ALBERT B. STEVENS has been added to the faculty of the University of Southern California as instructor in general engineering. He will give courses in engineering drawing, mechanics, and materials, and will also assist Prof. John F. Dodge in the division of petroleum engineering. Professor Stevens is a graduate of the University of California.

LINTON K. STARR, formerly director of public relations for the Georgia Power Company, has announced the opening of a new advertising and public relations service bureau in Atlanta. Mr. Starr, who following his graduation from Emory University spent a number of years as a member of the Atlanta *Journal* staff, became associated with the Georgia Power Company in 1921, when its public relations department was established, and remained with the company until 1930. He will place special emphasis upon that phase of operations having to do with the advertising and public relations work of large utility corporations.

▼ ▼ ▼

New England Power Makes New Appointments

EDWARD CABOT, for the past two years manager of the Quincy (Mass.) Electric Light & Power Company, has been

Edward Cabot

appointed manager of the Fall River (Mass.) Electric Light Company, effective Aug. 4. Mr. Cabot was graduated from Harvard College in 1920, and after a term of service with the Ludlow Manufacturing Associates, Ludlow, Mass., joined the staff of the New York Power & Light Corporation at Glens Falls, going from there to Quincy as resident manager for the New England Power Association.

Newall A. Clark, assistant manager of the Narragansett Electric Company, Providence, R. I., since April 1, 1929, has been appointed manager of the Quincy Electric Light & Power Company. Mr. Clark was formerly connected with the Fall Mountain Electric Company, Bellows Falls, Vt., another New England Power Association subsidiary.

Howard A. Stanley, vice-president of the Fall River Electric Light Company, has joined the engineering organization

N. A. Clark

of the New England Power Construction Company, Boston, Mass., and for the present will make his headquarters at Providence, R. I., reporting to J. Y. Young, district electrical engineer.

W. L. HICHENS, British financier, who accepted the chairmanship of the English Electric Company in October, 1927, as a temporary arrangement, has resigned that office and retired from the board now that the reconstruction of the company has been completed. Sir Holberry Mensforth has been elected to the board and appointed chairman of the company.

•

NATHAN C. CLARK, a graduate of the University of California in electrical engineering in 1927, has been appointed instructor in electrical engineering in the college of engineering of the University of Southern California. He will enter upon his new duties in September. Mr. Clark held the John W. Mackay fellowship during 1927-28 and a teaching fellowship in 1928-29 in electrical engineering at the University of California, dividing his time between teaching and graduate study. During the past year he has gained valuable engineering experience in the Television Laboratories, Inc., of San Francisco, and as special technical adviser for the U. S. Forest Service.

•

ALLEN E. RANSOM, formerly connected with the Central States Power & Light Corporation of Dubuque, Iowa, has been appointed to the staff of the U. S. Engineers by the Secretary of War. Mr. Ransom has had extensive engineering experience since his graduation from the Sheffield Scientific School of Yale University. He spent fifteen years with the Westinghouse Electric & Manufacturing Company in various sections of the country before affiliating himself with the properties of Charles Francis Adams of Boston. Later he was connected with the Fremont Power Company, Sumpter, Ore., and the Olympic Power Company, Port Angeles, Wash. After the World War he engaged in engineering work in the West, South and East, and from 1927-1930 he was identified with the Interstate Power Company and the Central States Power & Light Corporation of Dubuque.

•

E. M. LINDSAY, formerly superintendent of distribution of the Florida Power Corporation, has joined the staff of the Standard Management & Operating Corporation as supervising engineer on electrical construction. Mr. Lindsay will also supervise all construction work on the various gas plants and distribution systems that are being installed. He is a native of Georgia, where he completed a four-year course in electrical engineering, graduated with a B.S. degree in 1914 and later finished one year of post-graduate work, graduating in 1915 with an electrical engineering degree. Mr. Lindsay entered the testing department of the General Electric Company at Schenectady, N. Y., in 1917, but later in the year enlisted in the army and went overseas. Returning to Schenectady with the General Electric Company in 1919, he was transferred to the Atlanta office in 1920 as sales engineer. In the fall he was assigned to Jacksonville, Fla., as sales engineer and remained in that capacity until 1925, when he joined the Florida Power Corporation.

▼

G. E. Taylor Named General Manager of Dubuque Utility

GEORGE E. TAYLOR, formerly division manager of the Interstate Power Company, has been appointed general manager following a connection with that company which covers a period of twelve years. He succeeds to the position held by H. C. Orton, now vice-president and general manager of the Utilities Power & Light Corporation.

Mr. Taylor first joined the Interstate organization in the construction department, later becoming chief engineer of the Indiana State Power Company, a subsidiary of the Interstate. He was transferred to Dubuque six years ago to become chief engineer and for the past four years has been manager of the company's northern division.

▼

A. R. SMITH has been appointed executive engineer of the turbine engineering department of the General Electric Company to succeed the late William J. Delles. Mr. Smith will retain his responsibility as engineer of the construction engineering department. He has been with the General Electric Company since 1897 and with the construction engineering department since 1908.

▼

OBITUARY

SIGNOR GAETANO BONOMI, a leading Italian authority on hydro-electric installations, died recently at Lecco, Italy, at the age of 64.

•

HOWARD F. KILLEN, chief engineer of the Dayton Power & Light Company plant at Piqua, Ohio, died at his home in Piqua, August 1. Mr. Killen had long been identified with the Dayton utility. He was 63 years of age.

•

ALBERT R. BEAL of Poughkeepsie, a director and a son of the founder of the Central Hudson Gas & Electric Corporation, dropped dead on the golf links of the Powelton Country Club at Newburgh August 8. Mr. Beal was 54 years of age.

•

JOHN J. LYNG, vice-president of Electrical Research Products, Inc., New York, died August 9, of heart failure, caused by overexertion in rescuing his sister-in-law from drowning. Mr. Lyng was well known in the electrical engineering research field and had been vice-president of Electrical Research Products since 1928 in charge of engineering and technical development. He became identified with that organization, a Western Electric Company subsidiary, after an association with the Bell Telephone Laboratories, where he directed the activities of about 700 technicians. Mr. Lyng, who was a member of the A.I.E.E., was 55 years of age.

•

FRED D. LYON, engineer, of San Diego, Cal., died recently in that city. A native of Chicago, Mr. Lyon pursued his technical studies at the Armour Institute of Technology. From 1902 to 1905 he was engaged on the construction of the Fisk Street power house in Chicago, and for the next three years on construction of the Quarry power house. Then for a period of years Mr. Lyon engaged in various construction jobs, and in 1924 he was named general superintendent of the Cahokia power plant. Mr. Lyon has been active in the affairs of the American Institute of Electrical Engineers, being some few years ago chairman of the St. Louis section. He was also a member of the Western Society of Engineers, the Providence Engineering Society of Providence, R. I., and other engineering societies.

Financial and Statistical News

BROADCASTING the threat of possible rate reductions and ill effects of the drought, bear interests have succeeded in forcing utility stocks to new low levels for this movement. That rate reductions frequently boost consumption is of course disregarded when a so-called "corrective movement" is desired.

——OTHERWISE THE MARKET STILL AWAITS BETTER BUSINESS and industrial developments and a very large proportion of trading, probably well over 50 per cent, is professional.

▼ ▼ ▼

New Company Organized to Invest Abroad

IBERIAN ELECTRIC, LTD., has been organized in Canada with a capital of $34,000,000 through the instrumentality of the European Electric Corporation, Ltd., through its engineering and management affiliate, Italo-Belge, and the United Electric Securities Company, a subsidiary of the General Electric Company. Iberian Electric has been formed to invest in electric properties in Spain and Portugal and has acquired an interest in the Sociedad Hispano Portuguesa de Transporte de Electricos, in the Alberche Water Power Company and in the Seville Electric Company.

The Hispano Portuguesa company is building a hydro-electric plant with an ultimate capacity of 240,000 hp. on the Duero River in northern Spain at an estimated cost of $12,000,000. The Alberche company operates a water power plant on the Alberche River in Spain and the Seville company supplies electricity to the provinces of Seville, Cadiz and Huelva in southern Spain.

▼

Electric Power Obtains Holdings in Subsidiary

HOLDERS OF BOTH SECOND PREFERRED and common stocks of Power Securities Corporation are to be given the opportunity of depositing their stocks under plans which, upon becoming effective, will provide for the exchange of the second preferred stock of Power Securities Corporation for the $6 cumulative preferred stock of Electric Power & Light Corporation on a share-for-share basis, and for the exchange of the common stock of Power Securities Corporation on the basis of three shares of such common stock for one share of Electric Power & Light Corporation $6 cumulative preferred stock.

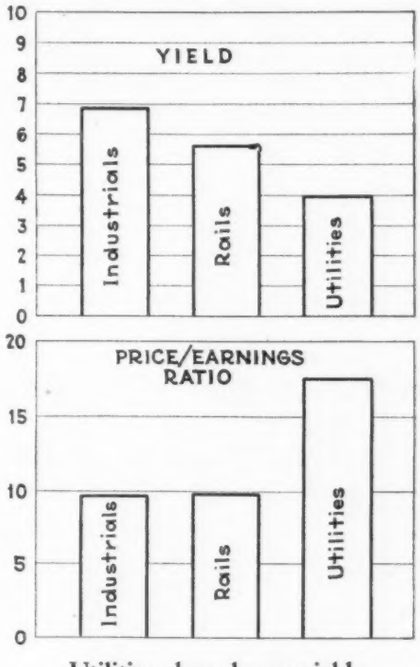
Two corporations, known as the Nanticoke Securities Corporation and the Schuylkill Securities Corporation, have been formed under the laws of Delaware for the purpose of acquiring shares of the second preferred stock and common stock, respectively, of Power Securities Corporation and offering these shares to Electric Power & Light Corporation for exchange.

At a meeting of the board of directors of Electric Power & Light Corporation held August 6 the corporation authorized its officers to acquire the second preferred and common stocks of Power Securities Corporation from the Nanticoke and Schuylkill Corporations on the above bases provided that a satisfactory number of shares of such second preferred and common stocks are deposited under the plans. Electric Power & Light Corporation now owns 28 per cent of the second preferred stock and 79 per cent of the common stock of Power Securities Corporation. The Guaranty Trust Company of New York has been named as depositary.

▼ ▼ ▼

Public Shows Marked Preference for Utilities' Stocks

PUBLIC appreciation of the merits of utility common stocks is vividly shown by a study of relative yields and price-times-earnings ratios of representative groups of industrials and rails.



Utilities show lower yield than other groups

As shown in the accompanying chart, the market valuation of a representative group of utilities has been such as to reduce the yield to 4 per cent, in comparison with yields of 6.9 per cent and 5.6 per cent on representative groups of industrials and rails respectively. The reverse side of the picture is seen in the lower chart, which shows the average price of the utilities group to be 17.7 times earnings, while industrials and rails are but 9.7 and 9.8 times earnings respectively. Prices are as of July 18 and are compiled by Standard Statistics Company, Inc.

The cumulative judgment of the investing public cannot be regarded as without foundation, although, naturally, the market may sometimes discount increased earnings of one particular group of securities farther in advance than seems warranted in the more sober judgment of leaders of that group. But in this particular case the facts strongly favor the utilities group. Earnings have shown less increase in the first half year, it is true, than in the first half of 1929, but are still 4 or 5 per cent over the 1929 totals.

The outlook has been somewhat clouded by threatened rate decreases, but any serious interference with normal earnings growth is not on the horizon. Railroads, on the other hand, have had their net earnings reduced by about

one-third in the first half, and industrials show a decline of more than one-fifth in net earnings. Furthermore, there is distinctly more uncertainty in the future earning power of these two groups than in the utilities picture. In other words, there is something behind the often seemingly flippant mass judgment which considers utilities' stocks worth fifteen to twenty times per share earnings. Any direct comparisons between different classes of stocks on a basis of price times earnings are meaningless and misleading.

▼ ▼ ▼

Warrants Gain Popularity in Utility Financing

THE use of warrants has "taken" much more extensively in public utility financing than in railroad financing, where the policy originated. Last year more than 14 per cent of all new issues in the utility industry carried some form of stock purchase warrants, a survey by the Guaranty Trust Company shows. These warrants are merely certificates entitling the holder to buy a given amount of stock, usually within a specified period.

One interesting feature of the use of warrants, especially last year, was their greater application with bonds than with stocks. According to the study referred to 22.3 per cent of all new utility bonds floated last year carried warrants to buy common stock. Warrants during the same period accompanied less than 10 per cent of stock issues. This is to be expected, since last year favored stock issues, generally speaking, and the slight added attractiveness in the case of bonds provided a slightly better price for them. Of course, it added a slightly speculative tinge.

The various types of warrants are classified thus: (1) Perpetual straight warrants, of which fourteen issues were outstanding as of January 30, 1930; (2) warrants of one price with a time limit, of which 28 issues were outstanding at the first of the present year; (3) warrants with a graduated scale of prices with time limits, the most popular form, of which 64 issues were outstanding as of January 1; (4) warrants in which the stock purchase price is determined by the priority of exercising. Only three issues of this type were outstanding at the first of the year.

▼

NEWS BRIEFS

American Equities Company has purchased the majority of the class B common stock of the Intercontinents Power Company from the founders or the company, Gannett, Seelye & Fleming of Harrisburg, Pa.; E. B. Robinette of Stroud & Company of Philadelphia, the Westinghouse International Company and E. H. Rollins & Sons.

•

Number of stockholders of the Middle West Utilities Company has increased to 75,796 from 64,188 in the beginning of 1930. A total of 55,857 stockholders now own common stock, 2,349 hold preferred stock and 17,590 hold preferred and common stocks.

•

An amendment to the charter of the Texas Electric Service Company of Fort Worth has been filed in the Secretary of State's office here, authorizing the increasing of its capital stock by issuing 20,000 additional shares of no par value. At the present time 2,000 shares of this stock will be issued. Proceeds from the additional stock will be used to carry out a program of expansion in the Fort Worth territory, the improvements to consist of new power plants and extensions of the power transmission system.

▼

Coast Company's Shareholders Increase Rapidly

THE NUMBER OF HOLDERS of Pacific Gas & Electric Company's stock continues to increase steadily. At June 30, 1930, the company's preferred stock was distributed among 40,463 investors, an increase of 9,957 within the year. This increase was due primarily to over-the-counter sales of 5½ per cent preferred stock, of which $6,776,000 was sold to 6,615 subscribers in the last year.

The common stock is held by 26,039 investors, an increase of 7,479 since June, 1929. Inasmuch as no common stock was sold to the general public during this period, this increase of almost one-third in the number of common holders indicates the steadily widening distribution of this stock among investors in the open market.

Total stockholders of all classes aggregate 66,502, of whom 54,274, or 81.6 per cent, are residents of California. In addition, the preferred stocks of the Great Western Power Company of California and San Joaquin Light & Power Corporation are held by 21,955 stockholders, of whom approximately 94 per cent reside in this state. An aggregate of 88,457 investors thus participate in the ownership of the consolidated system.

The following summary indicates that women predominate numerically in the company's stock registers:

	Number	Percentage of Total
Women stockholders	27,004	40.6
Men	26,604	40.0
Joint tenants (usually husband and wife)	10,927	16.4
Corporations, associations and institutions	1,967	3.0
Total	66,502	100.0

Employees of the company hold $4,287,000 par value of stock, which is distributed among 3,554 employees, or slightly in excess of one-half of the company's regular operating personnel, exclusive of construction forces.

▼ ▼ ▼

CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND POWER COMPANIES

	1930	1929	Per Cent Increase	Operating Ratio 1930	Operating Ratio 1929
American & Foreign Power (Year ended June 30)					
Gross earnings	$75,023,509	$45,554,230	65.0	..	..
Net earnings	37,269,328	23,502,343	59.0	..	..
American Light & Traction & subs. (Year ended June 30)					
Gross earnings	46,832,292	45,594,647	2.7	64	65
Net earnings	16,638,928	15,825,461	5.1	..	..
American Water Works & Electric & subs. (Year ended June 30)					
Gross earnings	55,060,661	52,208,685	5.4	50	50
Net earnings	27,391,986	25,817,496	6.1	..	..
Bangor Hydro Electric (Year ended June 30)					
Gross earnings	$2,175,281	$2,013,325	8.0	45	46
Net earnings	1,191,974	1,094,208	8.9	..	..
Engineers Public Service (Year ended June 30)					
Gross earnings	52,109,228	42,429,582	22.8	57	57
Net earnings	22,450,769	18,038,494	24.5	..	..
Federal Light & Traction & subs. (Year ended June 30)					
Gross earnings	8,471,197	8,267,641	2.5	57	59
Net earnings	3,620,484	3,389,437	6.8	..	..
North Amer. Lt. & Power & subs. (Year ended June 30)					
Gross earnings	46,714,276	44,374,418	5.3	55	56
Net earnings	21,142,460	19,418,474	8.8	..	..

July Manufacturing Lowest in 3½ Years

GENERAL manufacturing activity in the United States as a whole during July receded to the lowest level since December, 1926, and was 19.7 per cent below the computed normal for the month. The rate of general manufacturing was 9.0 per cent under June, whereas a 1.0 per cent drop is about normal for this period, according to figures compiled by ELECTRICAL WORLD on electrical energy consumed for power purposes by more than 3,800 manufacturing plants scattered throughout the country.

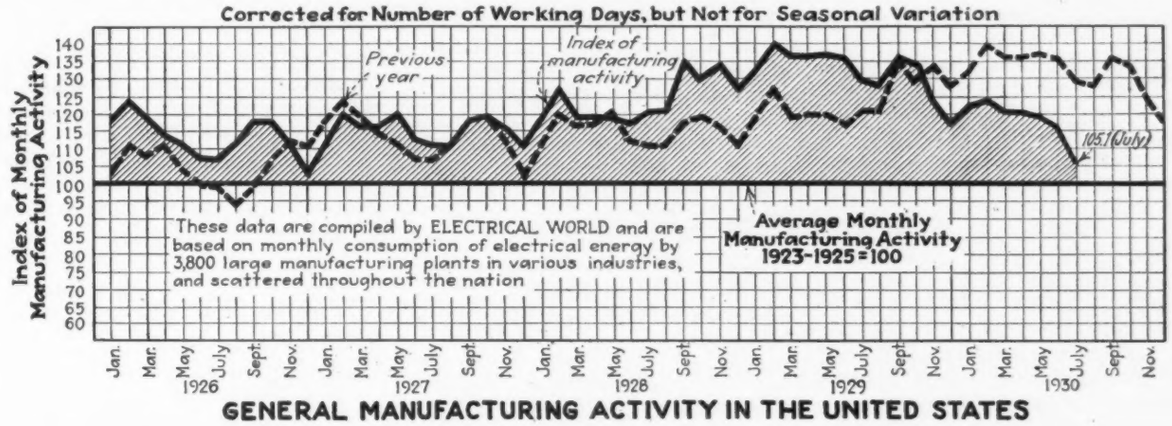
July operations were 18.5 per cent under July, 1929, and 12.6 per cent under July, 1928. The average rate of general manufacturing during the first seven months of the current year was 12.7 per cent under the same period in 1929.

Every section of the country witnessed a decline in rate of manufacturing operations during July as compared with June, and all but the Western States were operating on a plane materially under July last year. The greatest curtailment of manufacturing operations as compared with last year is shown by New England, with a decrease of 22.5 per cent under July, 1929, followed by the North Central States, with a drop in activity of 22.2 per cent; Middle Atlantic States, 14.6 per cent, and the Southern States, 7.2 per cent. The Western States reported a July rate of activity 1.2 per cent over July last year, due largely to increased operations in the food products and timber products industries of the section.

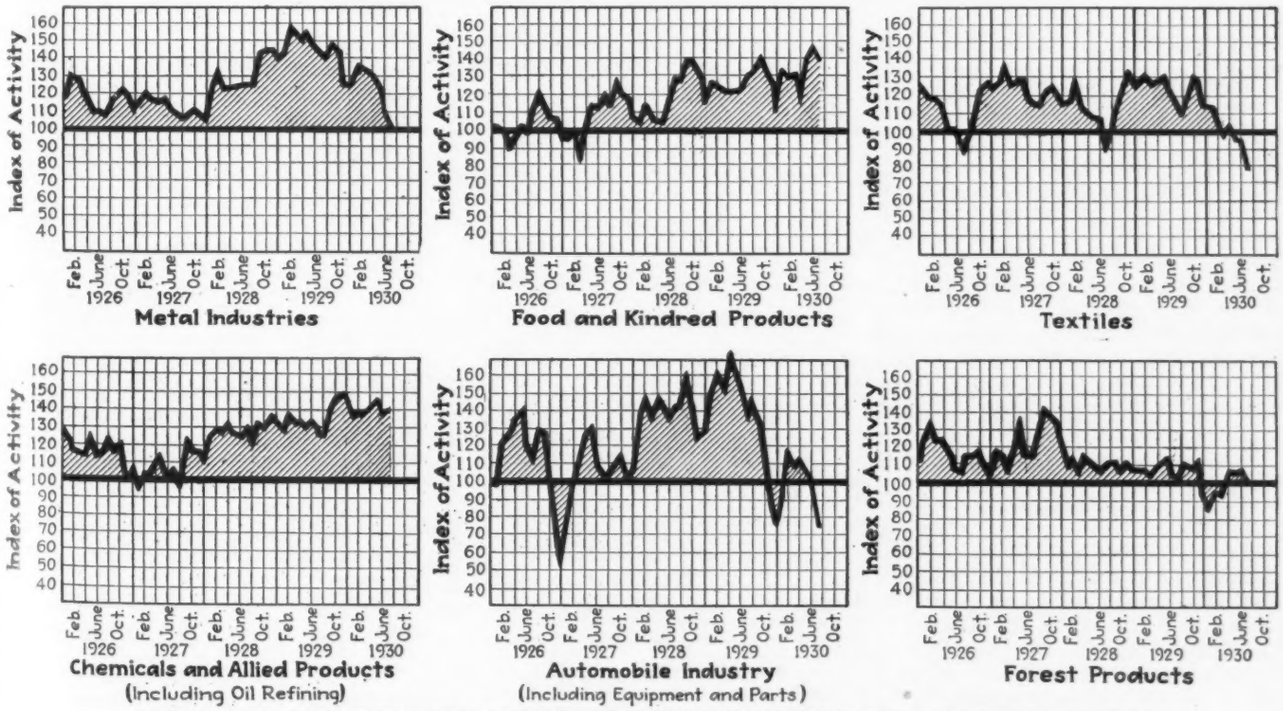
Current Manufacturing Compared With Other Periods

(Nation as a Whole)

Industrial Group	July, 1930 and June, 1930	July, 1930 and July, 1929	First 7 Mos. 1930 and 1929
All industry	— 9.0	—18.5	—12.7
Chemical products (incl. oil refining)	+ 1.4	+10.?	+ 6.2
Food products	— 4.3	+ 7.2	+ 6.9
Steel plants	— 4.8	—24.0	—16.4
Metal working	—10.0	—34.0	—18.5
Leather products	+ 0.5	+18.7	— 5.6
Lumber products	— 6.8	— 3.1	— 8.9
Paper and pulp	—14.4	— 2.0	+ 0.5
Rubber products	— 1.0	—24.1	—11.7
Shipbuilding	+ 4.5	+ 8.5	+ 9.1
Stone, clay and glass	—18.8	—28.4	—17.4
Textiles	—16.4	—29.7	—22.0
Automobiles (incl. parts and accessories)	—26.8	—46.0	—33.8


Corrected for Number of Working Days, but Not for Seasonal Variation
Index of Monthly Manufacturing Activity
Previous year
Index of manufacturing activity
105.1 (July)
These data are compiled by ELECTRICAL WORLD and are based on monthly consumption of electrical energy by 3,800 large manufacturing plants in various industries, and scattered throughout the nation
Average Monthly Manufacturing Activity 1923-1925=100
1926
1927
1928
1929
1930

GENERAL MANUFACTURING ACTIVITY IN THE UNITED STATES



ACTIVITY IN THE PRIMARY MANUFACTURING INDUSTRIES OF THE UNITED STATES

Business News and Markets

British Manufacturers See Worse Slump Ahead

THE IMPOSSIBILITY OF MAKING the gold standard work effectively while reparations and debt settlements disturb the normal economic trend is blamed by the British Electrical and Allied Manufacturers' Association for the world depression. Since this situation still exists, they anticipate even worse world economic conditions next summer than those already experienced.

The center of the trouble is the maldistribution of gold, say the manufacturers. Since the beginning of last year, they state, the United States and France have absorbed the equivalent of the world output of gold and have deprived central banks of probably a quarter billion in gold which is needed in trade.

"Recovery," the survey says, "will coincide undoubtedly with revision of the whole reparations system, with a view to accelerating the redistribution of gold over the world markets, and will depend, also, on the entrance of French long-term investment on a large scale into the world economic adjustment."

▼

Germany's Electrical Exports Up

ACCORDING TO THE OFFICIAL RETURNS just to hand, the imports of electrical machinery and apparatus into Germany during the five months ending with May last attained a value of only $4,538,750 as compared with $5,187,750 in the corresponding period of 1929. On the other hand, the exports of similar material from Germany reached a total of no less than $60,301,750, as contrasted with $56,644,750.

▼

Ford Buys Pumps

AN ORDER FROM THE Ford Motor Company for four vertical propeller type pumps with synchronous driving motors and control to be installed at the River Rouge plant, near Detroit, recently was placed with the Westinghouse Electric & Manufacturing Company. Pumps of this design are especially efficient for low heads and large capacities, making them particularly adaptable for this installation. The four pumps are to be used as boosters for furnishing the whole water supply to the River Rouge plant. The capacity of each pump is 157,500 g.p.m. against 14.5 ft. total head.

▼

Siemens & Halske Acquires Interest in Czechoslovakia

SIEMENS & HALSKE (A.G.) BERLIN, in collaboration with the Bohemian Union Bank, Prague, and the Maehrische Bank, Bruenn, Czechoslovakia, has organized the Elektrotechna A.G. fuer Schwachstromtechnik Prague, Czechoslovakia, with an authorized capitalization of 20,000 shares. It is stated that 49 per cent of the capital of the new company will be subscribed for by Siemens & Halske and the remainder will be raised by the banks mentioned.

TRADE BRIEFS

Westinghouse Electric & Manufacturing Company has begun the distribution of radio receiving sets and Westinghouse radios will soon be available for public inspection and distribution throughout the country.

•

Robbins & Myers Sales, Inc., announces the appointment of Thomas W. Quilter as manager of the Atlanta office and of W. S. Motter as manager of the Philadelphia office.

•

Blaw-Knox International Corporation is the new name for the export organization of the Blaw-Knox Company, formerly known as Milliken Brothers-Blaw Knox Corporation, which in turn succeeded the original Milliken Brothers Manufacturing Company.

•

Louis Allis Company announces the opening of three new sales offices—in

▼ ▼ ▼

Standard Ratings Adopted for Motor-Generators

STANDARD ratings of large synchronous motor-generators have been adopted by the National Electrical Manufacturers' Association. The rules give standard ratings for voltages, both direct-current and alternating-current; frequencies, kilowatt capacities and speeds for both two and three-unit sets of 200-kw. rating and over. Performance standards also are given for temperature rise, power factor and overload.

These rules will be included in the new standards of the motor and generator section of the association, which will soon be published.

The synchronous motor for standard synchronous motor-generator sets shall carry full load on the d.c. end of the set with 80 per cent power factor leading. During overload the field excitation shall be maintained at full load value.

Motor-generator sets shall carry the following overloads at full value of field current:

(a) 125 per cent load for two hours with temperature guarantee as given in Rule MG20-15.

(b) 200 per cent load in current for one minute without temperature guarantee.

Standard Temperature Guarantees

The standard temperature guarantees in degrees centrigrade for motor-generator sets when operating under normal rated conditions as specified on the nameplate shall be:

	A	B
Class of insulation		
Load per cent of rated current capacity	100	125
Time rating	Continuous	2 hrs.
Temperature rise		
1. Motor stator up to 1,500 kva. inclusive, deg. ther.	40	55
2. Motor stator above 1,500 kva., deg. temp. det.	50	65
3. Collector, deg. ther.	55	65
4. Motor rotor, deg. res.	60	65
5. Generator core and windings, deg. ther.	40	55
6. Generator commutator, deg. ther.	55	65

NOTE I—All temperature rises are based on an ambient temperature of 40 deg. C.

NOTE II—Overload run immediately follows the normal load run.

NOTE III—See Rule MG4-10 for descriptive specifications covering classes of insulation.

NOTE IV—Temperature specifications are limited to altitudes not exceeding 3,300 ft.

Pittsburgh, Pa., in charge of C. O. Sargent; in Tulsa, Okla., in charge of W. Woobank, and in Los Angeles in charge of A. R. Thomas.

•

Announcement has been made by the Fuller Lehigh Company, manufacturer of pulverized-coal-firing equipment and Bailey water-cooled furnace walls, of the opening of a new sales office in the Candler Building at Atlanta, Ga. J. McC. Hill is in charge of the new office.

•

Cutler-Hammer, Inc., has appointed Walter F. Price manager of the Los Angeles branch, which includes in its territory southern California and Arizona. Mr. Price has been a member of the sales staff of the San Francisco office of the Cutler-Hammer organization in charge of sales of its wiring devices and Trumbull Vanderpoel Manufacturing Company's safety switch line.

•

American Gas Accumulator Company, which for a number of years has been intimately associated with airway and airport lighting both here and abroad, has recently brought together in one department all of its aeronautical activities. In addition to distributing its own products the new division will also be the exclusive distributor for the B.B.T. Corporation of America and for the airway and airport lighting equipment made by the Sperry Gyroscope Company, Inc. L. C. Simpson has been appointed sales manager.

•

Creation of a new section to be known as the sales service section has been announced by M. C. Morrow, domestic appliance sales manager of the Westinghouse Electric & Manufacturing Company, Mansfield, Ohio. W. W. McFadden, who for many years supervised similar activities in the range section, is manager of the new section.

▼

Exports Down for June

FOR THE THIRD MONTH this year to date June shows a drop in exports from 1929 totals. The decline is about 6 per cent. This brings the aggregate for the six-month period to only 1.2 per cent over the first half of last year. The decline is pretty well distributed with respect both to product and country of destination.

Copper Requirements Largely Supplied

FOR THE THIRD SUCCESSIVE WEEK copper sales have shown a marked decrease, and it became evident that those to whom the price of 11 cents appealed had bought about all they wanted. Domestic requirements for the next three months have been purchased, and probably November and December consumption has been at least half booked.

Foreign consumers are not quite so well bought ahead, however, and are expected to continue in the market on a fair scale. The price has been firm at 11 cents all week, with 11½ cents realized in the Middle West and 10⅞ and 10.90 cents at points near the refineries, but in the last day or two the problem of the custom smelters again began to show its head.

	Aug. 6, 1930 Cents per Pound	Aug. 13, 1930 Cents per Pound
Copper, electrolytic	11	10¾
Lead, Am. S. & R. price	5½	5½
Antimony	8-8¼	7⅞
Nickel, ingot	35	35
Zinc, spots	4.80	4.65
Tin, straits	30.10	29¾
Aluminum, 99 per cent.	23.30	23.30

Exports of Electrical Equipment (Preliminary)

Article	June 1929	June 1930
Generators:		
Direct Current—		
Under 500 kva.	107,290	70,023
500 kva. and over	166,725	4,684
Alternating Current—		
Under 2,000 kva.	20,521	22,582
2,000 kva.	.....	.....
Steam turbo-generator sets	10,012	73,834
Accessories and parts for generators	60,881	55,067
Arc-Welding sets	.....	35,863
Self-contained lighting outfits	50,803	73,090
Batteries:		
Storage batteries	244,812	.....
6-volt storage batteries	.....	147,341
Other storage batteries	.....	63,379
No. 6 dry cell batteries	.....	54,498
Flashlight batteries	227,559	309,970
Radio B and C batteries (dry)	120,549	48,649
Other dry and wet cell primary batteries	136,028	16,939
Transforming or converting apparatus:		
Power transformers, 500 kva. and over	90,394	144,541
Distribution transformers, less than 500 kva.	124,819	213,624
Instrument transformers	29,597	14,327
Other transformers	96,500	153,414
Complete battery chargers under 15 amperes	13,041	15,895
Rectifiers, double-current and motor generators, dynamotors, synchronous, and other converters	88,546	64,235
Transmission and distribution apparatus:		
Switchboard panels, except telephone	101,489	154,400
Switches and circuit breakers over 10 amp.	245,446	226,260
Fuses	41,621	26,035
Watt-hr. and other measuring meters	93,117	53,685
Electrical indicating instruments	67,230	69,883
Electrical recording instruments	37,390	33,026
Other electrical testing apparatus	85,966	70,289
Lightning arresters, choke coils, reactors, and other protective devices	74,650	139,204
Motors, starters, and controllers:		
Motors, ¼ h.p. and under	208,704	189,929
Motors over ¼ and under 1 h.p.	79,896	65,732
Stationary motors—		
1 to 200 h.p.	417,091	293,055
Over 200 h.p.	16,255	87,301
Railway motors	20,620	21,316
Electric locomotives—		
Railway	11,805	7,702
Mining and industrial	16,369	59,515
Station and warehouse electric motor trucks	7,430	52,662
Starting and controlling equipment—		
For industrial motors	164,786	143,477
For electric railway and vehicle motors	9,373	19,116
Portable electric tools	101,645	75,991
Accessories and parts for motors	298,841	157,699
Refrigeration sets up to ½ ton capacity	1,102,099	.....
Refrigeration sets over ½ to 1 ton capacity	81,478	.....
Electric household refrigerators	.....	1,042,046
Electric commercial refrigerators up to 1 ton	.....	249,365
Thermodynamic refrigerators	.....	.....
Electric appliances:		
Electric fans	112,242	106,927
Electromechanical health exercisers	.....	9,793
Electric incandescent light bulbs, metal filament	104,636	.....
For automobiles, flashlights, and Christmas trees	.....	16,952
Other metal filament bulbs	.....	89,299
Other electric lamps	56,782	17,682
Flashlight cases	159,405	116,503
Searchlights and floodlights	33,952	37,099
Motor-driven household devices—		
Electric household washing machines	127,100	155,068
Electric vacuum cleaners	147,565	173,478
Other motor-driven devices, except tools	86,301	56,031
Electric flatirons	32,475	22,287
Electric cooking ranges	31,235	8,940
Other domestic heating and cooking devices	84,481	65,105
Industrial electric furnaces and ovens	20,149	157 685
Therapeutic and X-ray apparatus	168,532	88,632
Signal and communication devices:		
Radio apparatus—		
Transmitting tubes, sets and parts	335,498	71,738
Receiving sets	539,547	584,571
Radio receiving tubes	160,271	164,088
Receiving-set components	250,643	301,837
Loudspeakers	223,029	169,927
Other receiving-set accessories, n.e.s.	175,223	73,823
Telegraph apparatus	104,356	55,408
Telephone apparatus—		
Telephone instruments	52,289	45,172
Telephone switchboards	24,715	181,042
Other telephone equipment	306,103	258,767
Bells, buzzers, annunciators and alarms	23,405	23,330
Other electric apparatus:		
Spark plugs	171,467	106,446
Other starting, lighting, and ignition equipment	188,355	101,804
Insulating material	116,486	76,529
Metal conduit, outlet, and switch boxes	124,163	99,992
Sockets, outlets, fuse blocks, and lighting switches	170,696	136,559
Electric interior lighting fixtures	185,989	146,621
Electric street lighting fixtures	48,217	72,131
Other wiring supplies and line material	153,487	149,146
Other electrical apparatus, n.e.s.	894,419	954,604
Rubber and friction tape	45,092	28,445
Globes and shades for lighting fixtures	57,133	55,948
Glass electric insulators	45,096	18,151
Electrical porcelain:		
For less than 6,600 volts	57,960	42,310
For 6,600 volts and over	44,789	54,468
Carbons and electrodes:		
Electrodes for electric furnaces	133,895	188,993
Other carbon products	90,037	64,273
Insulated iron or steel wire and cable	19,424	9,505
Copper, bare wire	233,360	255,659
Insulated copper wire and cable	538,758	.....
Rubber covered wire	.....	94,509
Weatherproof	.....	31,587
Telephone cable	.....	8,452
Other insulated copper wire	.....	306,359
Totals	$11,550,135	$10,873,318
Six months ended June 30	$70,314,999	$71,149,595

Market Conditions

SLACKENING tendencies are evident in the equipment business in most sections. The fall outlook is beginning to look somewhat uncertain in the Eastern district. Appliance lines have been exceptionally active on the Pacific Coast. Industrial business is fairly well maintained.

▼ ▼ ▼

PACIFIC COAST

—SMALL APPLIANCE BUSINESS *has been especially active on the Pacific Coast this week. Wholesalers report a marked increase in number of inquiries and contractors report increased residence building, ranging from highly expensive homes to tract bungalows, especially in Vallejo, Monterey and the peninsula sections.*

Industrial business includes $16,000 worth of Westinghouse rotors and stators for Los Angeles and wiring material for the new Shell nitrogen fixation plant at Martinez. Prospective business covers a $1,000,000 film plant for Los Angeles, new theaters at several locations, such as Oceanside and Burbank, in Los Angeles, and $25,000 worth of motors and controls for a San Francisco shipbuilding firm. State buying has markedly increased, nearly all such material being destined for jobs in southern California. Machinery manufacturers report a poor demand for small motors. Meters and distributing transformers, small switchboards of the $2,000 size and circuit breakers are selling well, Los Angeles reporting a $95,000 order for circuit breakers and San Diego one for $25,000. Exceptionally heavy orders are reported from Los Angeles jobbers for fans, ranges and electric appliances, including a fan car, a car of miscellaneous small appliances and range orders aggregating $80,000.

Board of contracts and awards, Tacoma, is taking bids until August 25 for conveying equipment for municipal steam plant No. 2 and is considering bids opened on August 11 for approximately $30,000 worth of incandescent lamps. People's West Coast Power Company, at Longview, Wash., is planning immediate expenditure of $40,000 in extending transmission lines east of Cathlamet, and a company headed by John Rathkey of Ten-Mile, Ore., is planning a small hydro-electric development to serve the immediate district. Contracts for condenser and boiler settings for Eugene's $420,000 steam auxiliary totaling $35,000 have been awarded. Sales reported included 26 motors from 25 hp. down to dealers, ten from 50 hp. down to a mill and woodworking plant, one 50 hp. and several small machines for an eastern Washington sawmill, about 30 machines, from 20 hp. down, to scattered industrials. Sales of miscellaneous switchgear totaling $2,000 were reported with the statement that movement of high-voltage equipment in the Seattle district is expected to be light for the next 60 days, but that outlying districts show considerable promise, with a number of 55- and 13-kv. lines projected. In the past four months the Puget Sound Power & Light Company has sold 3,000 electric ranges.

CONSTRUCTION PROJECTS

Los Angeles Can Company, Los Angeles, Calif., plans plant to cost $175,000. Torrance, Calif., contemplates a municipal electric light and power plant. Los Angeles, Santa Cruz, Bakersfield, Inglewood and Anaheim, Calif., plan ornamental lighting systems. Great Northern Power Company, Everett, Wash., has plans under way for a hydro-electric power plant to cost about $4,000,000. St. Regis Paper Company, Watertown, N. Y., contemplates a kraft paper mill near Tacoma, Wash., to cost over $1,000,000. Municipal Power Department, Seattle, Wash., will build a power substation to cost $50,000. Quartermaster, Fitzsimons General Hospital, Denver, Colo., will receive bids until August 27 for power plant equipment. Oliver Power Company, Paonia, Colo., has final plans for steam-operated power plant to cost $200,000.

❖

SOUTHEAST

—THE NORMAL BUSINESS VOLUME *in the Southeast which was obtained during the past several months was increased during the past week by the addition of several sizable orders.*

A Tennessee utility company ordered switching gear to the amount of $15,000. A Georgia construction company ordered $30,000 worth of the same equipment. Switchboard equipment for the Furman Shoals development in Georgia to the amount of $16,000 was purchased during the week. A Georgia construction company purchased power transformers to the amount of $10,000. This construction company also purchased paint for the Atkinson steam plant to the amount of $8,000. A Georgia utility company purchased small transformers to the amount of $6,000, poles $4,000, meters $3,000, and installation material, breakers and arresters to the amount of $1,500. Reports from appliance campaigns in progress throughout the section indicate that the increased volume reported for appliances and other resale items several weeks ago will be maintained.

CONSTRUCTION PROJECTS

Virginia Polytechnic Institute, Blacksburg, Va., has approved plans for a mechanical engineering building to cost $225,000. Appalachian Electric Power Company, Bluefield, W. Va., is projecting plans for a hydro-electric power development to cost over $10,000,000, and has authorized a power substation at Bluefield to cost over $75,000. Woodcraft Novelty Company, Boone, N. C., plans installation of an electric generator set with accessories.

Alabama Coca Cola Bottling Company, Anniston, Ala., plans plant to cost $100,000. Deepwater-Black Creek Coal Mining Company, Jasper, Ala., plans extensions and improvements to cost over $100,000.

❖

MIDDLE WEST

—GENERAL BUSINESS IN THE *Middle West section continues to mark time. August, an admittedly slow month, has not indicated any definite change in general conditions so far, although some signs of returning business are being observed. A more optimistic feeling is being evidenced generally and it is thought that this month will definitely mark the beginning of better business.*

Various utility companies are outlining their construction schedules to begin on a larger scale in September and continue throughout the balance of the year. Some of the interesting orders placed this week include miscellaneous iron and steel to cost $60,000, soot cleaner elements valued at $20,000, elevator equipment to cost $30,000, insulators and supports valued at $13,000, "Mazda" lamps valued at $150,000 and several construction orders aggregating $100,000.

Jobbers' sales continue slow. General business is still somewhat spotty with improvement noted in railroad and municipal lines only. The unusually hot weather has stimulated the sale of electric fans and refrigerators to a large degree, other appliances moving in fair volume.

CONSTRUCTION PROJECTS

Spooner, Wis., has authorized the installation of a Diesel engine and accessories at the municipal power plant. Loyal Electric Power & Light Company, Loyal, Wis., plans extensions in transmission line. Detroit Edison Company, Detroit, Mich., has filed plans for an equipment storage and distributing plant at Pontiac, Mich., to cost over $175,000. Seneca Copper Company, Calumet, Mich., plans installation of

mining equipment, hoisting equipment, etc. Copper District Power Company, Houghton, Mich., has plans for a transmission line in Houghton County. United States Gypsum Company, Chicago, Ill., will build a gypsum mill at Hillsborough, near Moncton, N. B., to cost over $600,000. Goshen, Ind., contemplates a municipal electric light and power plant to cost $200,000. Columbus, Ohio, contemplates a municipal electric light and power plant to cost $150,000.

Tri-State College, Angola, Ind., has plans for a power plant to cost about $50,000. United States Steel Grave Vault Company, Galion, Ohio, plans plant to cost about $100,000. Citizens' Ice & Fuel Company, Toledo, Ohio, plans two ice-manufacturing plants to cost about $400,000. Northwestern Light & Power Company, Cedar Rapids, Iowa, plans power plant at Grundy Center, Iowa, to cost over $60,000. M. & L. Baking Company, Sioux City, Iowa, plans plant to cost $100.000. Holt Motor Company, Minneapolis, Minn., plans service, repair and garage building to cost $200,000.

❖

EASTERN

—MIDSUMMER TRADE SHOWS QUIET TENDENCIES *of more than usual extent in the Eastern district, with central-station account developing the heaviest volume of sales. Inquiries, however, both from power utilities and industrials, have reached a low level, making the immediate outlook for fall business very uncertain.*

—INDUSTRIAL DEMAND IS AT A LOW EBB *and only a few leading branches of activity seem to offer any immediate promise of sizable commitments. Electric railway business, which has been so heavy in recent weeks, appears to have contracted for all current requirements and is becoming passive; it is anticipated, however, that the next 30 to 60 days will show revival of buying in that quarter.*

A notable award for marine equipment has been secured by the General Electric Company, which will furnish the turbine-electric propulsion machinery for six vessels for the United Mail Steamship Company; the installation in each ship will consist of two turbo-generator units with total rating of 10,500 hp., with three 500-kw. d.c. turbine generating sets for lighting and auxiliaries, all of the latter to be electric-operated, as well as two propulsion motors, switchboards, control panels and complete accessories. Three of the vessels will be built by the Newport News Shipbuilding & Dry Dock Company, and three by the Bethlehem Shipbuilding Corporation.

The Westinghouse Electric & Manufacturing Company will furnish a battery of six generator units, each of 23,888-kva. rating, for a power project in Missouri, the installation to include motor-generator exciters and accessory equipment. A power company in West Virginia has awarded a contract to a New York manufacturer for generators for a hydro-electric power project, costing $750,000. An electrical works in Canada is advancing production and has placed an order for about 2,500 tons of copper bars, aggregating $550,000, for delivery in September and October.

A manufacturer of electrical equipment carrying its main accounts with jobbers says that while business is dull at present, all indications point to a decided revival next month and sizable account is looked for. A manufacturer of air compressors in New England has purchased a quantity of motors from a New York maker costing about $35,000. Electric elevator business is active in the metropolitan district. The Otis Elevator Company has secured a contract for 31 electric elevators of automatic self-leveling car switch control type for the new Waldorf-Astoria Hotel, as well as for three large passenger elevators for ballroom service, and for fourteen electric service elevators. Another electric elevator installation to cost about $50,000, for a building on John Street, has been let to a state manufacturer.

CONSTRUCTION PROJECTS

New York Power & Light Corporation, Albany, N. Y., is said to have surveys under way for a hydro-electric power project at Hudson Falls, N. Y., to develop a capacity of 100,000 hp. Corn Products Refining Company, New York, contemplates extensions and improvements in plant at North Kansas City, Mo., to cost over $1,500,000. New York *Telegram*, New York, will build a newspaper printing plant to cost $3,000,000. Buffalo General Electric Company, Buffalo, N. Y., has filed plans for power substation to cost about $50,000. Department of Public Safety, Newark, N. J., will receive bids until August 19 for underground cable for a police signal system. Perth Amboy, N. J., contemplates an addition to municipal electric lighting plant. Pennsylvania Power & Light Company, Allentown, Pa., plans addition to power plant at Harrisburg, Pa. Susquehanna Collieries Company, Philadelphia, Pa., plans coal breaker near Mount Carmel, Pa., to cost over $600,000. Hazel Brook Coal Company, Hazel Brook, Pa., plans coal breaker near Girardville, Pa., to cost more than $500,000. United States Engineer, Pittsburgh, Pa., will receive bids until September 3 for lock-operating machinery on Allegheny River (Circular 50.)

❖

NEW ENGLAND

—SOME SLOWING UP IN ORDERS *for heavy electrical machinery and central station supplies is noted in this district. Small motor sales compare favorably in volume with last year. Inquiries and negotiations are quiet.*

During the past week an order for a 3,000-kw. turbo-generator was received by one well-known manufacturer. An order consisting of substation control equipment amounting to over $10,000 was recently received for a Western plant installation. Small lot orders for insulators are being placed regularly; line materials are slowing up in interest. Small industrial power equipment sales are encouraging. Some specialties in electrical equipment, on the other hand, show increased activity; outside illumination for small recreation fields is active and sales of high-wattage lamps are gaining. Floodlighting units are in good demand; electric control meters for controlling industrial processes are selling well, and electric time-recording equipment is in strong favor.

CONSTRUCTION PROJECTS

Taunton, Mass., has approved plans for a power substation to cost close to $50,000. Simonds Saw & Steel Company, Fitchburg, Mass., will establish plant at East Fitchburg to cost over $300,000. L. G. Balfour Company, Attleboro, Mass., has plans for a power plant at jewelry factory to cost about $50,000. Vermont Marble Company, Proctor, Vt., has plans for a fabricating plant at Rutland Center, Vt., to cost over $200,000. Universal Winding Company, Providence, R. I., has filed plans for an addition to textile machinery plant to cost $100,000.

❖

SOUTHWEST

—THE GENERAL TONE OF BUSINESS *is better than was indicated by last week's report. The volume of sales in stock sizes of apparatus has been greater and some fair-sized contracts by utilities and industrials have been closed.*

An order was placed by a municipality in Missouri for a 1,500-kw. turbo unit with condenser to cost $50,000. A power company in the Southwest bought $10,000 worth of lightning arresters and regulator equipment, a 3,000-kw. bleeder type turbine unit to cost $60,000 was ordered by an oil refining company and $10,000 worth of motor control equipment by a plate glass manufacturing company.

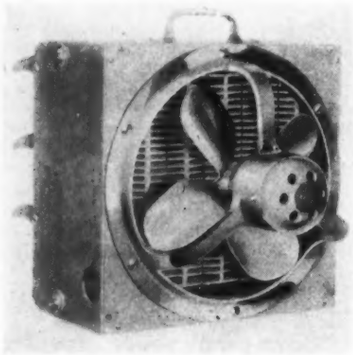
CONSTRUCTION PROJECTS

Board of Education, St. Louis, Mo., has filed plans for a power plant to cost over $100,000. Marquette Cement Manufacturing Company, St. Louis, Mo., has filed plans for an addition to storage and distributing plant to cost about $100,000. Kansas Power & Electric Company, Lawrence, Kan., has plans for a power substation to cost over $50,000, and for an equipment storage and distributing plant to cost $60,000. Oklahoma Straw Board Mills, Inc., Oklahoma City, Okla., plans mill to cost over $100,000. St. Louis & San Francisco Railroad Company, St. Louis, Mo., has filed plans for a power plant at Tulsa, Okla., to cost $60,000. Ozark Reduction Company, Little Rock, Ark., plans hydro-electric power plant on Buffalo River, near Jasper, Ark., to cost over $1,000,000. Paragould, Ark., plans bond issue of $125,000. for a municipal electric light and power plant.

New Equipment Available

Electric Space Heater with Fan Circulation

COMBINING THE CHARACTERISTICS of both the steam unit heater and the electric heater, a new type electric space heater announced by the American Foundry Equipment Company, Mishawaka, Ind., meets industrial and



commercial needs for both permanent and portable installations, according to the manufacturer.

The construction is simple, the special alloy heating strips being cast integrally with composite fins of aluminum alloy to make a single smooth casting that will allow an uninterrupted flow of air through its channels. These castings are assembled into a cabinet, back of which a fan operates to force a current of air through the fins and out into the space to be heated.

▼

Triangular Tower for Overhead Work

OVERHEAD WORK SUCH AS electric light maintenance, tree trimming, etc., may be facilitated by the use of the Trenton tower ladder recently placed on the market by J. R. McCardell & Company, Trenton, N. J. This structure, which is 25 ft. in height, may be easily mounted on any style truck. The outside section is hinged on a pivot to the side of the body so that it may be swung down into a working position. The tower is triangular in shape and at the top is a crow's nest which alleviates the danger of the workman becoming overbalanced and falling.

The inside section of the ladder slides through the outside section on 1½-in. steel rollers. A standard 2-1 block and fall with ½-in. rope is used for raising and lowering. The weight of the tower is 250 lb. and the outside dimensions 26 in. When fully extended the tower is rigid and does not sway, according to the manufacturer.

▼

DETACHABLE MOUNTING BRACKETS for use in connection with various sizes of porcelain core resistors are being manufactured by the Ohmite Manufacturing Company, Chicago. The springiness afforded by these brackets protects resistance units from shock and permits them to expand or contract without strain. When the bracket is mounted on an insulated surface there is no possibility of leakage from one terminal to another, according to the manufacturer.

▼

Perforated Reflectors Light Stack Aisles

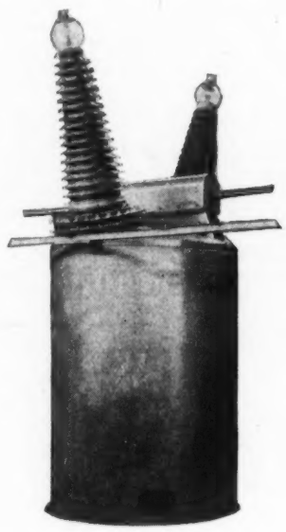
REFLECTORS FOR STACK AISLE lighting which control the direction and intensity of the light by means of a perforated reflecting surface have been designed by Snead & Company, Jersey City. The amount of light passing through the reflectors is regulated by the size and position of the perforations. Light not passing through these openings is reflected by a white vitreous enamel on the inside surface to distant points. A light baffle along the axis of the aisle protects the eyes from glare and has the effect of softening the illumination. When the reflectors are spaced 6 to 7½ ft.

apart the rays from one properly overlap those from the other, according to the manufacturer.

The new reflector is adapted for use wherever records, files or stock materials are stored in low, narrow corridors.

Oil Circuit Breakers for High-Voltage Use

OIL CIRCUIT BREAKERS which may be equipped for high-speed operation on circuits where system stability is involved and which conform to the new preferred system voltage ratings are announced by the General Electric Company for indoor and outdoor service.



These breakers are designated as type FHKO-239.

The breakers having high interrupting ratings are equipped with explosion chambers and those rated from 15,000 to 34,500 volts have rod and segment type contacts. At 46,000 volts and above butt type contacts are used.

Separating chambers allow the escape of gases without oil throw, and emergency vents are provided to relieve unusual pressure. The breakers are of boiler plate steel construction with round tanks, domed bottoms and domed tops.

▼

REVERSING CONTACTORS FOR SINGLE AND THREE-PHASE MOTORS of 1½-hp. 110-volt and 3-hp. 220-volt sizes have recently been placed on the market by the Industrial Controller Division of the Square D Company, Milwaukee. This device, designated as class 8711, is used primarily for operating control on small machine tools, window opening and closing apparatus, etc. The contactor consists of two double-pole, double-break contactors which are mechanically interlocked and mounted in a sheet steel case. The contacts are of silver and are easily removed without the use of tools. The armatures are full floating and the wiring terminals are located on the top to facilitate connections.

Electrical Industry Facts

Selected Statistics Point to Basic Business Trends

Oil Burner Load Increasingly Important

AT THE beginning of 1930 there were 419,500 domestic oil burners in operation in the United States using mechanical draft, according to satistics published by the Americal Oil Burner Association. In addition 115,500 were being operated on natural draft, bringing the total to 535,000.

The first-named group is of interest to the electrical industry; it constitutes a market for small motors and for the sale of energy. The number increased by 85,980 in 1928, by 94,520 in 1929 and will, it is estimated, increase by 95,000 in 1930. Not only the number itself but the annual increment also is growing.

A reasonable assumption for the average annual energy consumption per burner is 200 kw.-hr. Tests in Detroit indicated a group average of 258 kw.-hr. (ELECTRICAL WORLD, January 21, 1928.) Using the somewhat smaller value to take climatic differences into account and applying this to the mean of the number of burners operating at the beginning and end of the year gives 74,450,000 kw.-hr. for 1929; the corresponding estimate for 1930 is 93,400,000 kw.-hr.

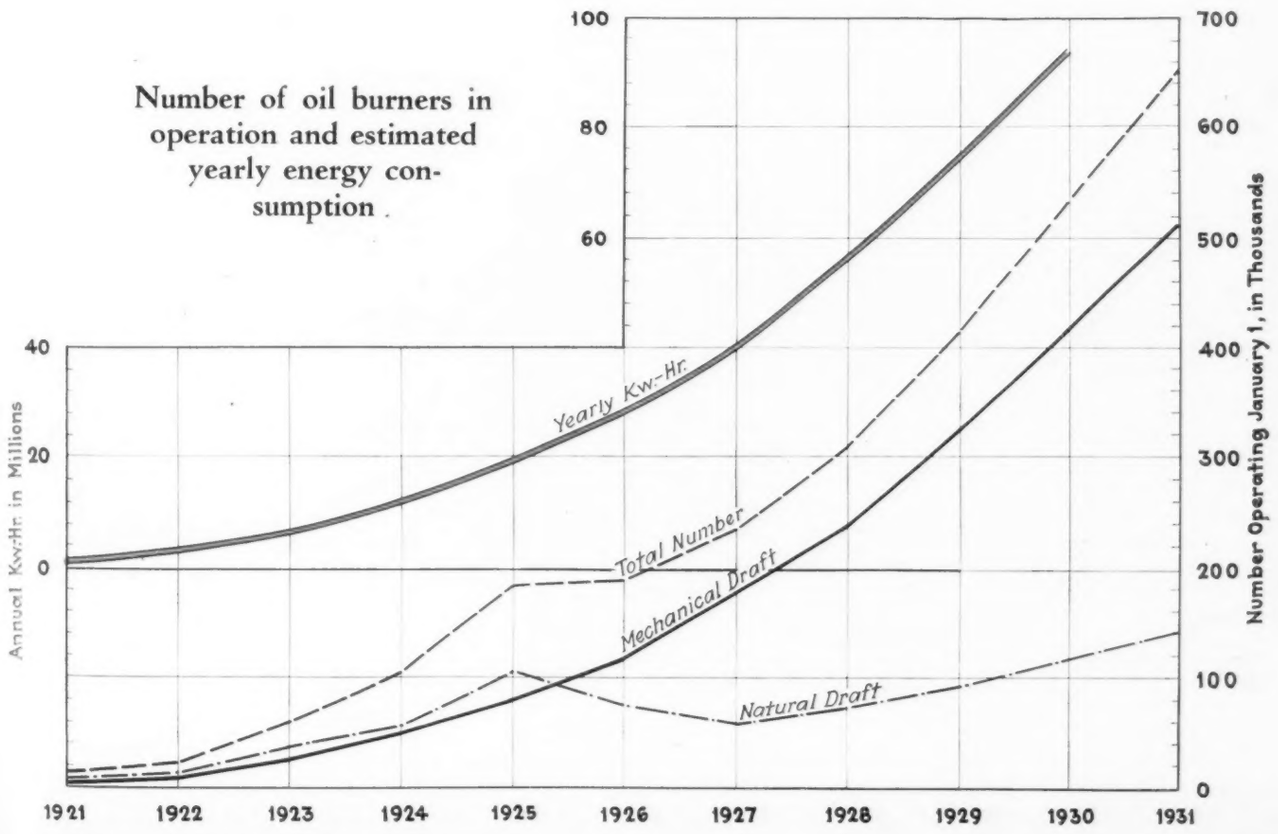
This is about 1 per cent of the total domestic load, and may therefore seem unimportant, but in the colder parts of the country, at least, an oil burner is equivalent to 50 per cent of the average consumption per domestic customer and much of the energy is off-peak.

*Domestic Oil Burners, Mechanical Draft**

Year	No. Operating Jan. 1	Yearly Net Gain	Year	No. Operating Jan. 1	Yearly Net Gain
1921	5,000	4,000	1927	177,000	62,000
1922	9,000	14,500	1928	239,000	85,980
1923	23,500	23,800	1929	324,980	94,520
1924	47,300	31,200	1930	419,500	†95,000
1925	78,500	35,400	1931	†514,500	.....
1926	113,900	63,100			

*American Oil Burner Association. †Estimated.

Number of oil burners in operation and estimated yearly energy consumption.



North Central Manufacturing Lowest Since 1926

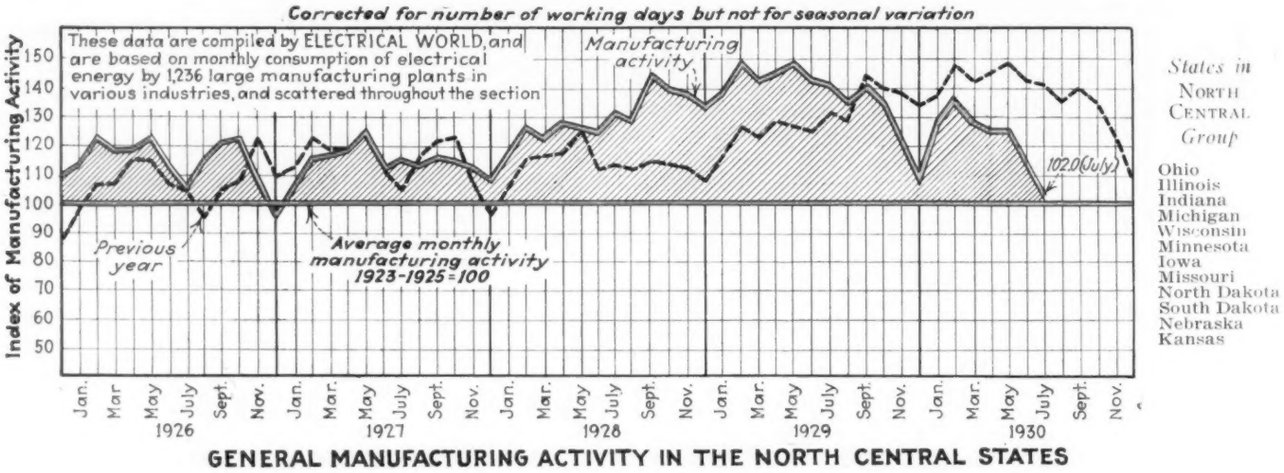
GENERAL manufacturing operations in the North Central States are at present on the lowest plane since the close of 1926. Monthly consumption of electrical energy by about 1,236 manufacturing plants in this section as reported to ELECTRICAL WORLD indicates that the rate of operations during July was 6.0 per cent under June and 22.2 per cent under July last year. The drop from June to July was about 6.0 per cent greater than would normally be expected for this season of the year. For the first seven months of the year the rate of manufacturing operations has averaged about 14.4 per cent under the same period last year.

The two leading industrial groups of the section—automobiles and metal-working plants—show the greatest decrease in operations, as compared with July last year. The automobile industry, including the manufacture of parts and accessories, recorded a rate of operations about the same as those of last December; July operations were 25.4 per cent under June and 48.0 per cent under July last year. The decreased activity during July was 21.5 per cent greater than the normal decrease for this season of the year.

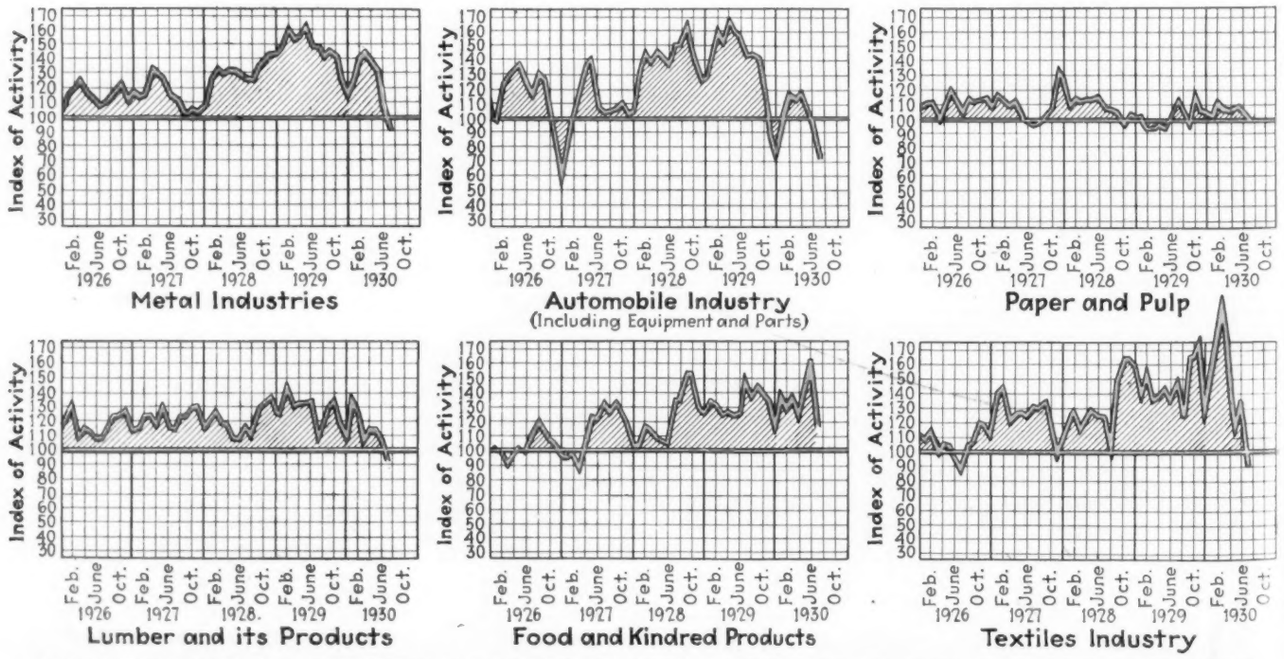
The ferrous and non-ferrous metal-working plants of the North Central States also recorded a radical drop during July, sinking to a plane 25.3 per cent under June.

How Current Manufacturing Compares With That of Other Periods

	July, 1930 and June, 1930	July, 1930 and July, 1929	First 7 Months, 1930 and First 7 Months, 1929
All industry	— 6.0	—22.2	—14.4
Chemical products	+54.2	+28.4	— 0.8
Textiles	—32.9	—40.1	+ 2.2
Lumber products	—12.5	—13.1	—12.6
Paper and pulp	— 6.9	—13.3	+ 4.5
Auto	—25.4	—48.0	—34.2
Iron and steel	+ 0.5	—19.6	—15.8
Metal-working plants	—25.3	—49.1	—22.1
Food products	—27.4	—21.6	+ 4.9
Leather products	—12.0	—32.0	—18.3
Rubber products	+ 5.8	—19.7	— 6.8
Stone, clay and glass	— 9.3	— 5.1	— 2.4



GENERAL MANUFACTURING ACTIVITY IN THE NORTH CENTRAL STATES



MANUFACTURING ACTIVITY IN PRIMARY INDUSTRIES OF NORTH CENTRAL STATES